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THE ROENTGEN TREATMENT OF ADVANCED CANCER [1]

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DURING the past three years, in this country, the roentgen therapy of cancer has presented, from a clinical point of view, an increasingly involved problem. Out of it, there seems to be developing the fact that high voltage, heavily filtered roentgen radiation is not the cure-all that some, at first, enthusiastically believed it to be, but that, when expertly used, it does afford one more weapon in the attack on a hopeless disease. The questions of clinical dosimetry, at first based on absolute physical constants, have become more confusing, especially since the biologic reactions to radiation are getting precedence over the physical in many investigations.

The idea on which intensive radiation therapy is based is the old one long held by surgeons, that to extirpate all cancer is to cure all patients. In other words, to kill cancer-growth is the ideal of radiotherapy. Yet clinical experience from neither surgical nor radiological points of view has demonstrated the infallibility of such a theory. Up to the immediate past, roentgen therapy of cancer has proceeded along lines laid down from the theoretical point of view that a homogeneous intensive dose is the optimum of treatment by roentgen ray. These are the well-known laws formulated by Dessauer. To this end, the intensity of all factors used in therapy has been increased. At present, clinical dosimetry, as restricted to the production and measurement of certain amounts of desired effective energy, does not present any essential difficulties.

The view has been held that biologic and ionization effects go hand in hand. Many dosimeters, both physical and biological, have been constructed. In the use of a dosimetric system, we have to assume that the readings of the dosimeter parallel the biologic effect, or that we know the variation between tissue reaction and wave length—or roentgen intensity—as checked by the dosimeter. But, although it is known that wave length and tissue reaction bear some relation, we have no irrefutable evidence at present that there is a strict parallelism between them, especially since the distribution of energy of hard and soft rays is not absolutely known. For that reason, it seems as if the wave length intensity most suitable for any kind of tumor must be determined from clinical or biologic experience, and that it cannot be predicted from physical consideration alone.

Some recent work by Wood has shown in certain experimental tumors that it takes the same number of erythema doses of both hard and soft rays to produce the same biologic effect under certain laboratory conditions. It seems desirable, therefore, to analyze the effects of rays of various compositions, such as are clinically used, and in this, not dispense with the biologic effect for comparative purposes, for it has not been definitely shown that the intensity of a clinical reaction or its characteristics is purely a function of the wave

[1] Read before the Radiological Society of North America, at Atlantic City, May, 1925.

length of the incident ray. Holthusen has outlined such a dosimetric study, and Friedrich has constructed his well-known ionization chamber, which, within the therapeutic wave length range, is independent of hardness.

At present, the evidence for and against massive killing doses delivered in a short-time interval is very conflicting. Most of those who decry low doses, in view of a possible stimulation effect on cancer, are gynecologists. Seitz and Wintz, for example, have shown an irritating effect with 30–40 per cent unit skin dose.

Kehrer said that a stimulating effect is produced in cancer at any site where the radiation intensity falls to the equivalent of 0.7 mg. radium. To avoid the possibility of stimulation, elaborate ingenious technics have been devised, both for delivering and measuring such an intense dose as will avoid all possibility of stimulation of cancer. The time and space distributions of such radiation have been carefully studied by many.

On the other hand, Holtzknecht, Jüngling, Pordes, Schintz, Czepa, Schwartz, Opitz, Gunsett and others have insisted that the Arndt-Schultz law, on which this theory of stimulation is based, is not a law at all, and that many of the evidences of stimulation of cancer by low roentgen doses are due to faulty observation.

They say that the conception that cancer cells receiving mild doses grow without restraint with rapid metastases, and that resting cells are irritated into free proliferation, is untenable. Holtzknecht points to thousands of cases receiving "insufficient" radiation over a period of twenty years, yet presenting few examples of uncontestable stimulation. Jüngling says that doses of from 20 to 40 per cent unit skin dose do not aggravate tumor growth. From a great number of studies, Ewing has pointed out the unlikelihood of cancer stimulation by the physical agents. *We* have pointed out that, in advanced cancer, at least, the technic of low and divided doses applied at intervals had produced satisfactory results and cited a few confirmatory cases.

In this country, in the past year, the pendulum seems to be swinging away from massive, intensive roentgen therapy doses, for, by its use in the hands of many, even though attempting to duplicate published technics in properly selected cases, the results not infrequently have been disappointing, and the damages inflicted on patients did not seem to justify radical work. At the meeting of the Royal Society of Medicine, in England, in March, 1924, the results of intensive therapy of cancer with high voltage, heavily filtered roentgen ray were admittedly disappointing. For some time past, Portmann, Bowing, Morgan, Sittenfield, Pfahler and many others have advocated a split-dose technic. The tendency in many instances is away from intense to very mild radiation, such as was indicated by Clark, Morgan and Asnis, in "A Preliminary Report on a Modified X-radiation Technic." (RADIOLOGY, October, 1924, pp. 273-284.)

It is pointless to deny that, to treat uterine cancer, a hard, heavily filtered ray is necessary. The very satisfactory Erlangen results in this field have been sought to be duplicated in breast cancer by the application of the same physical concepts, necessitating technics modified from uterine deep therapy, such as are advocated by Wintz in his book, "Die Roentgenbehandlung d. Mammarkarzinoms."

But, even on this basis, our results are not so outstanding, and it is questionable whether high voltage in breast cancer therapy, as routine, has any advantage in actual practice in treatment of advanced cancer. For many admit that satisfactory results were often obtained in the old days with 140 K.V. and 3 mm. Al. in cases of proven cancer of the breast, and lately, by technics such as reported by Lee and Herendeen, of the Memorial Hospital.

In contradiction to the view that the best clinical results are obtained by concentrating an effective roentgen dose on cancer with the aim of killing it, is the evidence

advanced by Ewing, Régaud, Forssell, Opitz and others, that in certain types of cancer the best results are obtained where not only the tumor, but also a normal surrounding zone, is rayed with a not-too-intense, prolonged radiation. Many authorities say that the production of reactions in normal tissues surrounding the tumor is very important. Murphy, for example, says that tumor regression is proportional to the lymphocytosis produced. Others, Theilhaber, Wintz, Hernaman - Johnson, strongly advocate raising the bodily reserve of all cancer patients undergoing radiation. In fact, there is some evidence to support the view that mild radiation increases resistance to cancer invasion, whereas heavy radiation diminishes it.

In dealing with a disease as dangerous as cancer, we are assuming too much responsibility by temporizing in its treatment with a not-too-conclusive idea of selectivity of reaction of normal and cancer cells. Yet we do not of necessity want a dose of homogeneous radiation, delivered to the tumor, gauged as percentage of skin dose, from the standpoint of tumor reaction alone. It has not been shown conclusively that there is a great margin of safety between damage to normal and to cancer cells, and a dose, damaging to these abnormal cells and, at the same time, beneficial to normal tissue, has not been proven.

Many clinicians have advanced the point that microscopic similarity—or even clinical indentity—between two tumors offers no proof that they will respond uniformly to physical agents. We have, at present, no definite method of clinically estimating cellular activity at the time of radiation, so that, at any given moment, we cannot be sure of a uniform reaction to a standard dose. It is very difficult to reduce complex biologic phenomena to mathematical functions, although formulation of tumor cellular activity gives us an encouraging starting point, and recent work of MacCarty and Broders is an important advance in this direction.

Clinical experience does not support the view that the delivery of the maximum practical intensity of roentgen ray—provided even that the patient can stand it—ensures that all cancer cells will be killed. There is no denying that, at best, X-ray is a shotgun, aimed at a deep-seated tumor from without, and that in its arrival at a subcutaneous tumor it must damage all tissues with which it comes in contact. We have no method at present of limiting our cross-fire strictly to a tumor whose size and shape we cannot exactly determine, so that we cannot concentrate on the actively growing peripheral zone of the tumor more rays than are effective in the immediately surrounding more or less normal tissues. Therefore, in damaging a neoplasm, some damage to normal structures seems unavoidable.

The argument that a divided dose is less effective than a heavy one is not uncontrovertible, for there is no absolute fixed biological or mathematical standard of reactivity for either normal or abnormal cells, to roentgen ray. Furthermore, the element of time in producing an effect loses in importance as the intensity of reaction (usually an upset) increases. It seems plausible that the dose effective in producing a result with the least complications, irrespective of its time relations, is the best one to employ, and that the economics of physical dosimetry should not outweigh clinical convenience.

So far, we have been dealing with cancer radiation therapy in patients where the clinical factors could be assumed to be in our favor; that is, cases in which a cure could be looked for by correctly choosing our therapeutic factors. But, as actual fact, most of the patients observed in this Clinic did not exhibit such ideal conditions by far. In most of them, the disease was no longer localized, and this spread was often accompanied by a considerable degree of cachexia. To take care of all the cancer in the body by a general radiation was impossible, because it was impossible to produce, in every focus of cancer, the

same effect we would if the disease were localized, since it is generally admitted that the systemic effect—usually an upset—is proportional, roughly, to the size and location on the skin of the various ports of entry. The total damage is the sum-total of the individual damages inflicted through the various skin areas irradiated. In therapy of cancer in the old, the feeble and the cachectic, it seems desirable to avoid—or, at least, minimize—reactions.

We have previously described our "erythema doses" and their iontoquantimetry. Our experience has been that the advanced group of abdominal cancers treated with a full dose in a single sitting usually did not do as well as those treated less intensely, and that this was especially true if two or more full doses were given in a short-time interval. To minimize upsets, we rarely use more than one-half an erythema at a time in a single sitting, but, by spreading the cycle of three to five ports into ten days to two weeks, we usually obtain satisfactory toleration of the irradiation. Ordinarily, we repeat this half-dose cycle in a month. No technic we have employed seems to have been effective in cases of metastasis to the liver and lungs.

From a statistical point of view, obviously, a report on cures in advanced cancer is absurd. But our results in inoperable cancer, hopeless from a surgical point of view, as was mentioned, are such that we do not feel justified in resorting to anything more drastic in such cases. To use killing doses seems out of the question, just as much as to rely on stimulation of body functions already at a low ebb.

In cases of advanced cancer treated with "half" doses, we have often seen remarkable spectacular improvement of indefinite duration. But, sooner or later, there was a general collapse with rapid generalization of the disease, in which state further radiation seemed futile. Our experience to date does not support the view that heavier or more frequent doses in the interval of improvement would have averted such a disaster. Often it seems as if we expected rather too much at the outset in the way of curative or permanent end-result.

Furthermore, although there is a theoretical risk, in using divided doses, of stimulating cancer growth, our clinical experience does not support this view. Stimulation of cancer when *rarely* seen by small roentgen doses may as well be accounted for by a breakdown of normal body resistance to cancer, and so not true stimulation.

We have seen several cases of advanced cancer in which good regression had been produced once, sometimes more, and then have seen the patient go to pieces all of a sudden. But we cannot, at present, finally explain its mechanism. It may be that the resistance of the body, both to cancer and to radiation, had been exhausted.

CONCLUSIONS

Out of this confusion of clinical evidence, there seems this conclusion to be drawn: Cases of advanced cancer should receive roentgen therapy, not with the idea of producing a cure but only of producing palliation. It seems most reasonable to use radiation in this advanced group merely to produce possibly a slowing-down of the malignant process by checking the activity of the tumor cells, by inducing tissue reactions to combat them, and, at the same time, to use other means to build up the patient's resistance so that the tumor, for the time being, may be rendered innocuous. In the roentgen therapy of cancer we need many more studies of the physical distribution of various X-ray energies in the tissues, and biologic studies of the effect of large doses at long intervals and of small doses frequently applied. At present, it seems as if the merits of all technics should be considered in the treatment of a given case of cancer.

REFERENCES

Wood, Francis Carter: Effects on Tumors of Radiation of Different Wave Lengths. Am. Jour. Roentgenol. and Rad. Ther., 12:474-481, Nov., 1924.

Holthuzen, Herman: The Relations between Physical and Biologic Dosimetry. Strahlenth., Berlin, 17:49, No. 1, 1924.

HOLZKNECHT, G.: The Therapy of Carcinoma. Fortschr., 32:94, Kongh. 1, 1924.
OPITZ: The Biologic Effect of Radiation in Cancer. Fortschr., 32:95, Kongh. 1, 1924.
SCHINTZ, H. R.: The Biologic Foundation of Roentgen Therapy. Fortschr., 32:101, 1924.
CLARK, W. L., MORGAN, J. D., and ASNIS, E. J.: A Preliminary Report on a Modified X-radiation Technic. Radiology, Oct., 1924, p. 273.
REGAUD: Some Biologic Effects of the Radiation Therapy of Cancer. Am. Jour. Roentgenol. and Rad. Ther., XII, p. 97.
LEDDY, E T., and WEATHERWAX, J. L.: Palliative Doses of Roentgen Ray in Advanced Cancer. Am. Jour. Roentgenol. and Rad. Ther., 1924, p. 429.

DISCUSSION

DR. L. E. PARISEAU (Montreal): From what has just been said and from private conversations I gather that "knock-out doses" are not as popular with us as they were. Many would fragment their treatments still more were they not apprehensive of a stimulative action from small doses of X-rays or radium. A very exhaustive study by Gunsett of Strasbourg was read last year before the French Society for the Advancement of Science. I was there to hear it and am now convinced that "stimulation" is a bugbear, not a fact. None of the proofs are conclusive; all of the disproofs are impressive.

Dr. Gunsett's paper deserves translation; it would completely reassure those who now consider themselves between "the devil and the deep sea."

DR. R. E. FRICKE (Baltimore, Md.): Dr. Leddy has brought up a very important point, that of high voltage and low voltage. It is an open question. At the Howard A. Kelly Hospital since last Fall we have been using water-cooled tubes, and giving massive doses of 240,000 volts at 40 milliamperes, mainly in pelvic and uterine cases, and we think that our best chance to cure is to give a large dose at the time of first treating. We have had no bad after-effects with this, and our results have been a little better than with our usual 200,000-volt treatment. With our stomach cancers, we have had to give fractional doses and divide them, but so far we have been very well pleased with the method.

DR. B. F. SCHREINER (Buffalo): Personally I do not believe in a stimulating dose of X-rays, yet recently there has been a man who, in experiments on peas, measuring the size of peas with known quantities of X-rays, has definitely shown that at a certain time in the development of the pea it can be stimulated so that it can take on increased growth. Now apparently this is a temporary thing, and very soon the controls will catch up. I bring this up in view of one of the latest investigations of stimulation with the X-ray.

DR. ALBERT SOILAND (Los Angeles): Dr. Leddy's article covers very thoroughly the accepted belief of the men who are watching the advance work of radiology to-day. I think his address is one of the most scholarly presentations I have ever listened to, taking in the whole subject as we understand it to-day. I do not think it makes any difference whether you use high or low voltage, you have to get the energy of radiation in the manner and amount that the patient can tolerate. We can measure and weigh and calibrate everything under the sun except the patient's tolerance. We cannot measure the patient, and we have to view this matter in the final analysis from the position of the physician, the clinician. We have to treat that patient with the X-ray in the best way we know of to-day, and until we can guarantee the biologic reactions and know what the X-ray really does to the cell, we have to continue on along present lines.

CERTAIN DIFFICULT PROBLEMS IN THE TREATMENT OF CARCINOMA OF THE LOWER JAW [1]

By FREDERICK M. JOHNSON, M.B. (Tor.), ATLANTA, GEORGIA

THE successful control of cancer of the lower jaw[2] is still a matter of doubt and difficulty. The subject presents so many aspects that in this communication nothing more will be attempted than a short survey of certain facts, gleaned from an examination of the records of Memorial Hospital, New York City, for the years 1914 to 1924, inclusive.[3]

DIAGNOSIS

For any method of treatment to be uniformly successful, early diagnosis is essential. In spite of the intensive publicity campaign of the last decade, and the awakened interest of the medical and dental professions in all matters concerning cancer, the fact remains that in the year 1924, patients with carcinoma of the lower jaw, applying for relief, presented tumors as far advanced as any seen in previous years. The reason for this is not clear. Squamous cancer, whether arising from the mucous membrane of the lower jaw or from the epithelial surface of the body, has similar characteristics. It is one of the most frequent tumors, and should be recognized with ease. In many instances the delay is due to the patient's utter disregard of the early signs and symptoms. Then, too, nearly 40 per cent of the patients of this series first consulted a dentist. This is readily explained by the development of many carcinomas in the chronically inflamed gum surrounding an infected tooth. The dentist, after the extraction, is confronted by a mass of new tissue which for a time is believed to be "proud flesh." This grows rapidly, fills the tooth socket, and a mushroom-like tumor sprouts outwards to the sides of the jaw. If the true condition is not recognized, temporizing measures lead to irreparable harm and costly delay. Nor is our own profession entirely blameless. Syphilis is the first, instead of the last, diagnosis that often is made. A syphilitic lesion that could be confusing is extremely rare. If in doubt, a minute piece of tissue from the edge of the ulcer should be removed for microscopic examination; it often will prevent an unnecessary course of syphilitic remedies. Out of this large series of 122 cases, it is impossible to find the record of one early cancer. In no instance did the ulcer measure less than 3 cm. in its longest diameter.

PRE-CANCEROUS LESIONS

Leukoplakia, chronic fissures and papillomas are pre-cancerous in nature. In 19 patients, leukoplakic patches surrounded the tumor; in one instance the association was very striking.

A male, aged 61, was seen in the clinic with a typical squamous-cell cancer of the right lower jaw. Close by were areas of thick, furry leukoplakia which crossed the midline at the symphysis, and extended to the opposite side. Four months later, the man drew attention to a sore that had developed on the left lower jaw. It was a squamous carcinoma arising on the site of the previously noted leukoplakia.

Perhaps no region of the body fulfills Billroth's doctrine of the importance of chronic irritation in cancer production, as well as the oral cavity. Tobacco abuse, a poorly constructed denture, syphilitic change and chronic tooth infection are capable of initiating a tissue response which

[1] Read by title before the Radiological Society of North America, at Atlantic City, May, 1925.

[2] The term "cancer of the lower jaw," as used in this article, refers to epidermoid carcinoma commencing in the mucous membrane overlying the bone, and not to the smaller group of cases which have an origin in embryonal remnants of the enamel organ.

[3] The writer is indebted to Dr. Douglas Quick, with whom he was formerly associated, for permission to study the case records from his service at the Memorial Hospital.

in some instances is the cancer itself, in others an intermediate stage. The dental health was noted in 101 instances, and invariably was reported as badly neglected. *Cancer of the lower jaw rarely occurs in a clean mouth where the normal alkaline reaction of the saliva is retained.*

CLINICAL CONSIDERATIONS

Basal-cell carcinoma arising from the mucosa covering the mandible is a curiosity; our records show the occurrence only of the squamous-cell variety. Generally speaking, two distinct types are seen, the papillary and the infiltrating. A correct recognition of the type indicates, to an extent, the probable radiation response, and gives, as well, a basis for estimating the future life history. Papillary tumors seldom destroy periosteum, invade the bone or produce metastases until very late in their course.

A male patient, aged 45, suffered from an abscess of the lower molar tooth. This tooth was badly extracted by a dentist, with the result that a broken root was left in place. Later the root became dislodged, penetrated the gum, and was cast off, a persistent sinus being the result. Some time later, the sinus became tender, and an ulcer formed at its orifice. For seven months this was neglected, after which the patient came to the clinic for advice. Examination revealed the presence of a large, excavated neoplastic ulcer, intimately attached to the jaw, and involving the cheek and floor of the mouth. Hard, fixed nodes were present in the neck, and the mandible was invaded extensively. The patient was weak, cachectic, and unable to take solid food. The disease, which was of the infiltrating type, advanced rapidly and ten months after its onset was fatal.

Contrast this with the course of events when the growth is of the papillary variety. A man, aged 52, had worn complete upper and lower dentures for four years. The lower plate was rough and had irritated the gum of the left bicuspid region. For twelve months he had watched a tumor developing in this area, and only when it became too bulky for the denture to be worn did he seek medical treatment. The growth was as large as a plum, soft, ulcerated and only loosely attached to the bone. The jaw was not invaded, nor were the lymph nodes palpable. After appropriate treatment, the patient was clinically free of disease for over three years before he was finally lost to the observation department.

Fig. 1. Typical invasion of mandible by squamous carcinoma, showing the irregular osteolytic process.

Roentgenograms of the lower jaw were made in nearly every case; they showed that destructive invasion of the bone rarely occurs except in the infiltrating type, in which case the moth-eaten appearance of the alveolus is characteristic (Fig. 1). In treated cases, as a result of radium effect *and infection*, the bone may undergo inflammatory change, which is seen on the roentgenogram as an ill-defined loss of density (Figs. 2, 3, 4); ultimately a sequestrum forms in most instances (Fig. 5). The two bone changes, actual carcinoma invasion, and radium osteitis with necrosis, must be sharply distinguished. The X-ray appearances are characteristic, and as a rule offer little difficulty in interpretation.

Fig. 2. Clean-cut loss of substance of the alveolar margin due to sepsis and interstitial radiation.

Fig. 3. Same case as Figure 2, four weeks later. Small pieces of sequestrum have been removed in the interval.

Bone which was normal before treatment and then shows loss of density three to four weeks after treatment, should not be mistaken for late cancer destruction.

TREATMENT

The control of the primary growth, and the management of neck metastases, are two separate and distinct problems.

The Primary Tumor.—In the light of present knowledge, unfiltered emanation tubes buried in the cancerous mass should not be replaced by any other method of radiation. As a preliminary measure, heavily filtered radium or X-ray should be applied to the lesion from a distance. In a few instances, filtered needles in the tumor or filtered tubes over the tumor have been used. The experience gained indicates that the bare tube possesses advantages that are essential to a permanent result. If silver tubes, in a dental mold, ever are indicated, it is only in the early tumor, a type which, at the present time, seldom is seen. Successful surface treatment, as carried out in lip cancer, depends on multiple surfaces for cross-radiation effects. Unfortunately these conditions are not encountered in lower jaw carcinoma.

Professor Régaud, of Paris, for some years has been using filtered needles of low strength, for interstitial application. They are recommended for intra-oral lesions, and, it is stated, have not the disadvantage of unfiltered emanation tubes. When the milder method of Régaud is proven to be as valuable as the bare tubes, its adoption will be urged; but the impression has been gained by the trial use of platinum needles in selected cases, that only a temporary, partial regression is obtained. For permanent results in squamous cancer, the dosage must be increased to such an extent that caustic effects are produced as regularly as by the use of bare tubes.

One of the great disappointments of radium therapy is that the permanent control of squamous carcinoma requires caustic action of some extent at least. Except in a very few instances (the reason for which is not apparent), nothing less has been found sufficient. *The only cases of this report which to-day are free of disease at the site of the primary tumor were given the benefit of radiation up to the point of caustic effect.*

An analysis of the records has led to the conclusion that, before any treatment is instituted, serious consideration should be

Fig. 4. Radium osteitis of the lower jaw. A sequestrum is commencing to form.

Fig. 5. Same case as Figure 4, four months later. The sequestrum is loose and ready to be lifted from its bed. Radium osteitis plus infection.

given the patient suffering from mandibular carcinoma. If the decision is made that only palliation is possible, it is a grave question what type of radium therapy is indicated; certainly nothing as radical as bare tubes. Palliation of squamous cancer of the oral cavity is a very difficult problem. Complicating mixed infection alters the entire picture. Heavily filtered radiation from a distance has only a temporary influence. In squamous carcinoma of the uterus, it is possible to heal the surface, reduce the growth activity, and prolong life—a real palliation. This, however, is accomplished in a relatively insensitive and functionless organ, which cannot be compared to the highly specialized, constantly active structures of the oral cavity. To attempt palliation in the mouth by intensive radiation is to greatly increase the suffering of the patient; life is not prolonged, and in many instances is shortened, by the ill-advised attempt at improvement. But on the other hand, if complete regression is hoped for, treatment should be energetically instituted. The insertion of bare tubes in a lesion close to the jaw not only produces slough, but, in addition, exposure and necrosis of the bone. It is not possible to use an amount of interstitial radiation necessary to destroy the cancer, without altering the subjacent alveolus. Radium osteitis, and the train of suffering that follows, is a serious complication. Weeks and months of harrowing neuralgic pain, referred to the area of distribution of the fifth cranial nerve, tries the endurance of the strongest patient. The soft tissue slough is separated long before the necrotic bone is cast off. Until this occurs, pain dominates the scene.

Invasion of the mandible by cancer is not, in itself, a contra-indication to treatment. Emanation tubes, if placed close to the bone over the involved area, provide adequate radiation. It is the amount of soft tissue tumor in the mouth and in the neck, considered in conjunction with the general health of the patient, that finally decides the status of the case.

After the primary growth is treated, the future care of the patient becomes a potential surgical problem. If the radium osteitis is not severe, the sequestrum is only a thin shell of bone, and the strength of the patient remains unimpaired; mouth hygiene is all that is necessary until the healing is complete. In other instances, however, less conservative measures are required; the bone inflammation is very extensive, and the pain is exhausting. Formerly it was

not thought that much could be done to improve the local condition or to even relieve the deterioration of the patient. However, the results obtained recently in five such cases lead to the conclusion that the removal of part or all of the lower jaw is an operation that is followed by marked symptomatic relief. There is immediate cessation of pain, nourishment is taken with less difficulty, and the general health of the patient is improved. It must be emphasized that operation is recommended only for the removal of dead bone, the soft tissue tumor having been previously cared for by radiation. The amount of mandible excised depends upon the extent of destruction. In two patients, the resection of one-half of the body with its ramus was necessary. In the other three, the ramus was left intact. The operation is performed under local anesthesia through the usual submaxillary incision. The lymphoid structures of the triangle, together with the submaxillary salivary gland, are removed with the mandible; they are invariably swollen, brawny and closely adherent to the jaw because of infection. A fistula seems unavoidable, but with careful nursing, healing is complete in three to four weeks.

Neck Metastases.—Dr. Douglas Quick[4] has stated the conservative attitude in regard to lymphatic glands. Their protective function is respected, and only when palpable metastatic deposits appear, is surgical removal advised. As a routine in all cases of intra-oral cancer, the cervical lymphatics are given an erythema exposure of heavily filtered X-rays or radium. If, later, the neck tissues are disturbed surgically, either for jaw excision or lymphatic resection, bare emanation tubes are inserted in the wound at suspicious points, especially where lymphatic chains are severed.

Because squamous cancer in its spread affects one, or at the most two or three nodes in the chain, limited operations are occasionally practised. If the submaxillary group only is involved, a removal of this chain along with the submaxillary salivary gland is undertaken. If the deep cervical group is affected, the nodes along the internal jugular vein are excised, from the omohyoid muscle below, to the mastoid process above. To facilitate this, the sternocleidomastoid muscle is resected in difficult cases. If a metastatic focus is found to have broken through the gland capsule, and to be growing unrestrained in the tissues, radical removal is not attempted; under these conditions excision accomplishes nothing, while in many instances the implantation of bare tubes in the mass produces satisfactory regression. External radiation, on the other hand, has only a partial control over the onset or the growth of metastatic squamous carcinoma. Practically all the very advanced cases of this series sooner or later showed bulky metastases to the submaxillary and the deep cervical groups of glands. The earlier the primary lesion and the more anterior its situation, the greater was the tendency for only the submaxillary group to be involved at first.

Of twenty-two cases that are under observation metastatic glands have been removed in eleven. The deep cervical chain was affected twice, the submaxillary group seven times, and in one instance carcinoma was present in both chains. Bilateral deposits were definitely present in one patient.

HEMORRHAGE

Fortunately during recent years, this has not been a frequent complication. In the early period of the work, patients in whom the soft-tissue tumor was too extensive for benefit were accepted for treatment. Vigorous radiation was followed by deep slough; when this commenced to separate, a large artery, like the lingual, sometimes was opened. The first hemorrhage seldom was dangerous, but in a few hours or days bleeding usually recurred, and if the patient was without proper care, it often proved fatal. Now the danger is

[4] Quick, Douglas: The Conservative Treatment of Cervical Lymphatics in Intra-oral Carcinoma. Jour. Am. Med. Assn., Aug. 6, 1921, p. 436.

recognized, and if an unusual amount of slough forms, the patient is admitted to the hospital, and under local anesthesia the external carotid, lingual and facial arteries are ligated; if the nodes are enlarged and indurated a neck dissection is performed.

TRISMUS

A posterior lesion always is associated with inflammatory trismus, which appears about four weeks after treatment. When healing is complete, scar-tissue contraction may necessitate stretching the jaws under general anesthesia.

RESULTS

Statistics in the treatment of malignant disease are misleading and of little value unless a time interval of several years has elapsed. However, it may be of interest to indicate that twelve patients are being seen from time to time in the out-patient department of the hospital, who have been clinically free of disease for varying periods, as follows: Four cases for one and a quarter year; five cases for two years; two cases for two and a quarter years; one case for seven years.

Of these, six were operated on for neck metastases and three for jaw resection. In three, roentgenograms showed definite invasion of the jaw bone by cancer.

In addition, one patient was free of disease for four and a half years, another for four years, three for three years and two for two years. Ultimately they were lost to the clinic, so it must be assumed from a statistical standpoint, at least, that they finally succumbed to their disease.

CONCLUSIONS

(1) Cancer of the lower jaw must be recognized in the early stage before any method of treatment will produce uniform and favorable results.

(2) An analysis of 122 cases shows that there are two distinct clinical types, the papillary and the infiltrating, which differ both in their life history and radiation response.

(3) Unfortunately, the successful radium treatment of the primary tumor involves a caustic action of the soft tissues and the underlying bone. In some cases, subsequent excision of the mandible hastens the convalescence.

(4) Palliation of squamous cancer of the lower jaw is a very difficult problem. It would appear that only when there is reasonable hope of complete clinical regression should active treatment be given. An unwise selection of cases may produce great harm, but little benefit.

(5) A conservative attitude in regard to cervical lymphatics is advocated.

THE ROLE OF RADIATION IN THE TREATMENT OF CANCER OF THE BREAST [1]

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HISTORICAL

BREAST cancer was probably one of the earliest recognized forms of malignant disease. Being superficially situated, progressively enlarging, frequently ulcerating and associated with inevitable death, attention was early directed towards its treatment. The Papyrus Ebers, written about 1500 B.C., describes treatment by such methods as pastes, the cautery and excision; and that even more extensive surgical procedures than mere removal of the affected breast gained favor as long ago as 500 B.C. is shown by writings of that period, which mention the association of involved glands with cancer of the breast and include discussions as to the advisability of simple removal or of wider operations. This would indicate that our present surgical methods in the treatment of breast tumors are technical refinements of ancient methods and that asepsis, more radical operations and radiation are the only contributions to the treatment of this disease which have developed since ancient times.

Soon after Roentgen discovered the X-rays in 1897 certain individuals experimented with their use in the treatment of various diseases. The first to apply the roentgen rays in the treatment of breast cancer were Gocht, Katzenburg and Derks, in Europe, and in the United States, Merrill, of Washington, D. C. During the past twenty-eight years the technic of application of the X-rays in therapy has undergone many changes, from unfiltered radiation to heavily filtered high voltage, with the coincident essential development of progressively more efficient apparatus; but until within the last few years there has been no standard method for the measurement of dosage. Indeed, even at the present time there is still no standard technic for the treatment of any disease by roentgen therapy, but each individual therapist uses methods which are based largely upon his own experience. It is obvious that years of study of technical and of biological problems are needed before roentgen-ray therapy can reach the high standard of present surgical methods.

In order to reach conclusions regarding the efficacy of any method of treatment of malignant disease and to make comparative statistical studies, it is necessary to classify each case according to the location of the primary growth, the extent of the disease and the type of cell. Unfortunately in the case of breast cancer this has not been universally done, and, therefore, there is considerable confusion in the reports bearing upon this subject.

CLASSIFICATION

In the past it has been customary to classify breast cancer according to operability, thus dividing all cases into two groups—operable and inoperable. Since such a classification is based upon the skill and experience of different individuals it is subject to considerable variation and is correspondingly unsatisfactory. Thus, some surgeons may consider any case inoperable in which there is any clinical evidence of glandular metastases, while others will operate upon many cases in which there is rather extensive involvement of the axillary glands.

In an excellent discussion of the subject, Lee and Herendeen have differentiated between operable and inoperable cases according to the following plan:

> A primary inoperable cancer of the breast may be defined as one in which any one of the following factors is present: (1) definite fixation of the tumor to the chest wall; (2) marked involvement of the axillary nodes and extension

[1] Read before the Radiological Society of North America, at Atlantic City, May, 1925.

beneath the clavicle; (3) diffuse invasion of the skin, with or without subcutaneous nodules; (4) fullness of the supraclavicular regions or palpable supraclavicular nodes; (5) palpable nodes in the opposite axilla or supraclavicular area whose presence can not be explained by some other pathological condition.

There are certain early cases falling into the operable group that have a much more favorable prognosis than others, and as a rule these can be differentiated clinically with fair accuracy. It would seem that these cases should be placed in a different classification from those in which the outlook is less favorable. For several years in Germany it has been customary to separate cases according to the grouping of Steinthal, and though this classification is not entirely satisfactory it is simple and broad enough for clinical application. The groups of Steinthal are described as follows:

Group I.—Slow growing or small tumors still localized within the breast, without involvement of the skin, and with minimum involvement of the axillary glands, which are small and may or may not be found at operation.

Group II. — Distinctly enlarging, movable tumors, with or without slight involvement of the skin and with palpable axillary glands.

Group III.—Cases in which there is a wide involvement of the breast, the tumor being fixed to the skin and underlying tissues, frequently with involvement of the supraclavicular glands.

It is not always possible for the clinician to classify each case before operation, for it is not always easy to determine the extent of the axillary metastases. However, the axillary glands are potentially involved in every case and only careful microscopic examination can prove that they are free from metastases. The percentage of cases without any evidence of axillary involvement is small, probably less than 5 per cent. The cases which fall into Group II present the most difficult problem, both from the point of view of operative technic and curability. The percentage of cures among cases in Group III must be comparatively small.

These considerations make it apparent that surgeons and roentgenologists, in justice to themselves, as well as for statistical studies, should classify all cases of breast cancer according to some standard plan similar to the groups of Steinthal.

In accordance with this general plan we find that our own material, which includes 829 cases, can be classified as follows:

Group I. — Cases without clinical or microscopic evidence of involvement of the axillary glands—4 per cent.

Group II.—Cases in which the axillary glands are involved—81 per cent.

Group III. — Advanced cases, with involvement of the supraclavicular glands—15 per cent.

Among our cases, therefore, 96 per cent have shown some degree of glandular involvement.

DURATION AND PROGNOSIS

For prognostic purposes and for a comparative study of the curability of malignant disease by various methods of treatment, it is necessary to know the "life expectancy" of both the treated and the untreated case. In cases of malignant disease the life expectancy is subject to many variations, so that we may be led to believe that the life of a patient has been prolonged by our treatment, when, according to the average expectancy of life, he might have lived as long or even longer if he had not been treated. In the case of breast tumors it is sometimes difficult to determine exactly when a cancer began to develop. In some cases in which the tumors are of long standing, carcinomatous changes may be considered to date from the incidence of such rather sudden unusual symptoms as a rapid increase in growth or a discharge from the nipple. It should be borne in mind, however, that the fact that a patient has had a tumor of the breast for a certain period of time does not necessarily mean that it has been malignant throughout that period.

In a study of the records of Middlesex Hospital covering forty years, Lazarus-Barlow and Leeming found that the natural average duration of cancer of the breast at the primary site was 36 months. Lee reports an average duration of 40 months among cases at Crocker Memorial Hospital. Paget gives 48 months, de Kop 29 months, Sprengel 27 months, Rodman 30 months, and Haggard and Douglass state the average duration before operation as 26½ months (Table I).

TABLE I

NATURAL DURATION OF CANCER OF THE BREAST

(Compiled from the Literature)

Lazarus-Barlow and Leeming	Ave.	36	mo.
Paget	"	48	"
de Kop	"	29	"
Sprengel	"	27	"
Sibley, Baker, Giss, Williams	"	34	"
Lee	"	40	"
Rodman	"	30	"
Haggard and Douglass	"	26	"
Average		34	"

From these data we may conclude that the average duration of life for patients with cancer of the breast is about three years and that the average case may live as long as this untreated. However, as some cases are known to live twenty or more years while others may succumb in a few months we can not prognosticate the life expectancy of an individual case on the basis of any definite knowledge; nevertheless the average natural duration may have some bearing upon the choice of treatment. It should be borne in mind always, however, that conclusions based upon three-year results are of little value for comparative studies of various methods of treatment.

The prognosis in any individual case depends upon the age of the patient, the extent of involvement, the duration of the disease, the resistance of the patient and the type of malignant cell. It is well known that in the case of a cancer of the breast in a young woman the prognosis is unfavorable, this being especially true if the disease develops during pregnancy. The extent of involvement usually indicates the prognosis, and this can usually be determined; occasionally, however, there may be distinct metastases, even though a tumor may be small and associated with little or no demonstrable axillary involvement.

In a study of the material at the Johns Hopkins Hospital, Bloodgood found that the proportion of five-year cures after surgical treatment was 70 per cent if the axillary glands were not involved, and about 20 per cent if there was any axillary involvement. At the Massachusetts General Hospital, Greenough found that 12 per cent of the cases with palpable axillary nodes were cured. Ewing accepts Finsterer's estimate of 4.3 per cent of cures as the average result of surgical treatment in cases in which the axillary glands are palpably infected. Sistrunk reports that 39.5 per cent of the cases at the Mayo Clinic showed no axillary involvement, and of those with axillary involvement 19 per cent lived for five or more years. Halstead found that death occurs in 23.4 per cent of the cases in which there is no microscopic evidence of involvement of the axilla, and Rodman says that 90 per cent of his cases which showed early recurrence had palpable axillary involvement.

The resistance of the patient is generally considered to be an important factor in the prognosis, but unfortunately this can not be predetermined. It is greater in older than in young women, and according to my own experience fat women succumb more easily than the less robust.

Broders believes that the prognosis bears a direct relation to the resistance of tissue changes, such as lymphatic infiltration, hyalinization and fibrosis.

PRECANCEROUS CONDITIONS

There are certain benign or inflammatory conditions that are said to become

malignant. These may sometimes be confused with true malignancy and so may possibly influence statistical studies, especially as to the duration of the disease. Chronic mastitis, cystic mastitis, adenomata and senile involution may show areas of malignant changes or may actually become malignant. Even microscopic findings are not always conclusive in these cases as small areas of malignancy may be missed. Ewing says:

> Tietze, in 43 cases of cystic disease, found cancerous areas in 3 and computes that 10 per cent of cases of cystic mastitis develop cancer. . . . In 5 of 18 breasts classed as senile involution he found suspicious areas suggesting cancer, especially in the peripheral portions. Of 295 cases of various types of chronic mastitis collected by Speese, 15 per cent were reported as showing carcinomatous changes. In 28 cases of cancer of breast Verga found that in 5 the organ was the seat of cystic mastitis, with pronounced carcinomatous metaplasia. In my own material about 50 per cent of the breasts excised for cystic disease show pronounced precancerous changes or miniature carcinomas.

Among 350 cases Bryant found carcinoma in 80; among 365 cases Goss found carcinoma in 71, these series showing an average incidence of 21 per cent. Shield reports an incidence of 10 per cent.

The treatment of precancerous conditions by radiation has not been developed, although Pfahler says that most, if not all, cases of chronic mastitis can be cured by radiation.

SURGICAL RESULTS

To determine the relative value of the roentgen-ray treatment of breast cancer we must determine the average results obtained by surgical treatment alone, in order that we may compare these with the results in cases treated by surgery plus radiation and in those treated by radiation alone. In studying the surgical statistics we find a fair average among many operators, but in some cases there is a variation in the figures that may be due to differences in the selection of cases for operation. Before 1890 the average surgical curability of breast cancer was probably not over 10 per cent, the improved results since that time no doubt being due to the more radical procedures introduced by Halstead and Willy Meyer in 1894. Since that time surgical technic has reached its utmost development in the complete removal of all the available tissues surrounding the cancer, so that no future improvement in surgical treatment may be anticipated.

Walther studied a series of 61 reports covering a thirty-year period and reports the average surgical results as follows:

1891-1900—No. of reports 10; No. of cases 1,000; Three-year cures 26.5%
1900-1910—No. of reports 32; No. of cases 5,000; Three-year cures 32.8%
1910-1921—No. of reports 19; No. of cases 3,000; Three-year cures 34.9%

The results in over 2,000 cases, as quoted by Willis, show three-year cures in 31.2 per cent and five-year cures in 27.4 per cent. It will be noted that in this series the loss between the three-year and the five-year period is about 4 per cent.

Lindenberg gives a report of 50 statistical studies for the period from 1901 to 1910 which shows an average of three-year cures varying from 20 to 30 per cent. He quotes the three-year cures from the Rostock Clinic as 32.7 per cent, and from the Bier Clinic of Berlin as 33 per cent (1903); Schloffer's Clinic (1922) reported 44.3 per cent of three-year cures, and the Clinic of Boss at Breslau, 53 per cent. In a very large group reported by Rodman the average number of three-year cures since Halstead's report in 1894 was 29.4 per cent; and since 1910, 40.4 per cent for three years and 26.9 per cent for five years (Table II). Our own results are shown in Table III.

TABLE II
SURGICAL CURABILITY OF CANCER OF THE BREAST
(Compiled from the Literature)

	Survival Period	
	3 year	5 year
Walther, 1900-1910....	32.0%	
1910-1921....	34.9	
Deaver and McFarland..	34.0	26.0%
Warren, 1904	33.0	
Halstead, 1907	38.3	28.9
Steinthal	33.6	33.3
Willy Meyer, 1905....	35.8	
Schwarzkopf, 1895-1910	29.4	21.0
1904-1911	42.9	
Smith, 1911	43.0	17.0
Judd	44.7	39.8
Greenough	28.7	22.9
Bauchman	38.9	23.5
Deelman		30.6
Brostrum	29.2	23.9
Gassmayer	37.7	20.3
Rostock Clinic	32.7	
Bier Clinic	33.0	
Schloffer Clinic	44.3	
Boss Clinic	53.0	
Rahm	27.5	15.9
Lehmann	32.0	28.0
Iselin	48.8	36.4
Forgue	44.0	22.0
Perthes	38.5	27.7
Tichy	38.7	20.9
Handley	48.9	
Hoffmann	36.3	28.5
Peck and White.....	40.0	39.1
Neber	37.5	21.0
Lindenberg	42.1	31.4
Mills	49.2	36.8
Primrose		44.4
Watson Cheyne	54.5	52.1
Average	38.6%	28.8%

From this enormous amount of material we may conclude that there can be little doubt that at the present time the average survival after operation for cancer of the breast is three years in about 37 per cent, and five years in about 25 per cent. As stated above, the average duration of life of patients with untreated mammary cancer is three years. Not more than 33 per cent of the cases which have been operated upon live to the five-year period, therefore it would seem that we can anticipate the prolongation of life by operation in less than one-third of these cases.

In studying the surgical cures according to the groups of Steinthal, we find very favorable results in the cases in Group I, which includes those free from axillary involvement. Saltzstein reports the cures in cases without glandular involvement for various clinics as follows: Crile, 80 per cent; Johns Hopkins, 85 per cent; Harper Hospital, 80 per cent. Sistrunk and MacCarty report a similar group with five-year cures in 65.1 per cent. Steinthal's own three-year cures, as reported by König, are given in two series: Group I, 78 per cent and 85 per cent; Group II, 29.4 per cent and 32.2 per cent. Anschütz reports the results at the Kiel Clinic as 100 per cent cures among cases in Group I, and gives the same figure for the Giessen Clinic, this figure decreasing to 80 per cent for the five-year period. König's own study showed 100 per cent three-year cures for Group I; for Group II, 31.4 per cent cures for the period from 1900 to 1918, and 47 per cent for the period from 1918 to 1921 (Table IV).

We may conclude that the average curability for cases in Group I—that is, cases without glandular involvement—is approximately 70 per cent for five years; for Group II, about 25 per cent for five years, and for Group III, according to the few reported cases, approximately 4 per cent for five years.

In reporting their results many surgeons have not differentiated cases that may have had radiation, so that in the reports included above as giving the results of surgical treatment it is reasonable to suppose that some of these cases did receive radiation. However, the average results differ so little that we may consider that the above figures represent fairly the results of surgical treatment alone.

TABLE III

RESULTS OF SURGICAL TREATMENT IN 345 CASES

(Cleveland Clinic Series)

Period since operation	Living, without recurrence	Living, with recurrence	Dead, without recurrence	Dead, with recurrence	Dead, cause unknown
Less than 3 years	39.1%	14.0%	2.0%	20.6%	5.5 %
3 to 5 years	28.1	8.7	2.3	7.8	.87
5 or more years (Dec. 10, 1924)	23.1	6.0	2.6	4.6	.58

TABLE IV

SURGICAL CURABILITY ACCORDING TO STEINTHAL'S GROUPING

(Compiled from the Literature)

	Group I		Group II		Group III	
	3 yr.	5 yr.	3 yr.	5 yr.	3 yr.	5 yr.
Crile	..	80 %	..	..	..	..
Johns Hopkins	..	85	..	..	..	..
Sistrunk	75.6%	65.1	36.6%	21.9%	..	..
Anschütz (Kiel Cl.)	100	..	..	..	..	..
Steinthal (1)	78	..	29.4	..	..	..
(2)	85	..	32.2	..	..	..
König	100	..	31.4	..	..	..
von der Hutten, Giessen	82.6	52.1	37.8	22	6.0%	4.0%
Hoffman, Heidelberg	..	60	..	24.4	..	4.5
Average	87%	68.4%	33.5%	22.8%	6%	4.3%

RESULTS OF POST-OPERATIVE RADIATION

A discussion of the results of radiation in the treatment of breast cancer was instigated by Perthes, who, in 1920, reported that since his cases had received post-operative intensive radiation the number of recurrences had increased. Surgeons and roentgenologists of Germany at once undertook a statistical study of the entire problem of radiation. It is stated by Rahm that among 26 surgical clinics only 13 reported that they used post-operative radiation as a routine measure. According to Jüngling, only the clinics at Kiel and Vienna and that of Rostock reported that absolute improvement was secured by post-operative radiation and those clinics that reported the best results used a number of small doses and avoided large homogeneous radiation of the whole chest.

In reporting his results, Perthes divided the cases into four classes, as follows: Class I, non-radiated cases; Class II, cases in which insufficient radiation was given—one light dose; Class III, cases which received sufficient radiation—several doses of light therapy; Class IV, cases which received intensive radiation. The reports of Perthes, Tichy, Loosen and Kastner are represented in tabulated form in Table V.

Kastner's report, in which he uses Steinthal's grouping for cases treated by intensive radiation, includes three patients in Group I, of whom all lived for one year, but two were in bad condition; 32 cases in Group II, 12 of whom (37 per cent) died in less than two years, and only 19 (59.4 per cent) were free from cancer; 7 cases in Group III, all of whom were dead at the end of the first year. He compares these results with those of 69 cases which did not receive post-operative radiation. This series included 6 patients in Group I, among whom one had a recurrence in the

TABLE V

RESULTS OF POST-OPERATIVE RADIATION OF BREAST CANCER

(Groups of Perthes)

(Compiled from the Literature)

	Not radiated			*Insufficient radiation*			*Sufficient light radiation*			*Intensive radiation*		
	recurrence		cure	recurrence		cure	recurrence		cure	recurrence		cure
	1 yr.	2 yr.	3 yr. 5 yr.	1 yr.	2 yr.	3 yr. 5 yr.	1 yr.	2 yr.	3 yr. 5 yr.	1 yr.	2 yr.	3 yr. 5 yr.
Perthes	28 %	..	.. ..	38.5%	..	.. ..	37.5%	..	.. ..	41.0%	..	.. ..
Tichy	11.2	..	.. ..	41.7	..	.. ..	32.0	..	.. ..	45.5	..	.. ..
Wassinck and VanRamsdonk	28.0	..	.. ..	38.5	..	.. ..	37.5	..	.. ..	41.0	..	.. ..
Rahm	..	..	27.5% 15.9%	47.0	23.5%	.. ..	40.0	10.0%	30.0% 39.0%	44.4	11.1%	33.3% ..
Lehmann	..	..	32.0 28.0	..	..	.. ..	36.0	22.5	36.0 ..	47.6	..	.. ..
Kastner	33.0	..	.. ..	..	..	.. ..	..	..	60.0 ..	50.0	..	.. ..
Forssell	..	..	.. ..	..	..	.. ..	..	..	.. ..	..	..	.. ..
von der Hutten (Giessen)	..	..	.. 26.9	..	..	.. ..	..	..	30.5 ..	..	..	.. ..
Hoffman (Heidelberg)	..	..	38.7 20.9	..	..	37.7% 31.8%	..	..	.. ..	..	..	.. ..
Mayburg (Tichy)	..	..	.. ..	..	..	30.5 20.3	..	..	38.5 27.7	..	..	.. ..
Turbengen	..	..	32.7 ..	..	..	.. ..	..	..	47.5 ..	..	..	.. ..
Rostock	..	..	.. ..	18.0	3.0	36.0 ..	31.0	..	41.0 ..	..	..	.. ..
Loosen (Frankfort)	..	..	32.0 ..	..	..	.. ..	..	..	77.0 ..	..	..	.. ..
Walther	..	..	48.8 36.4	..	..	.. ..	..	..	60.0 55.5	..	..	.. ..
Anschütz	..	29.0%	.. ..	..	..	.. ..	..	27.0	.. ..	..	..	.. ..
DeSmit	..	..	.. ..	..	..	.. ..	42.0	..	43.0 ..	..	..	.. ..
Linder	..	..	.. ..	..	..	.. ..						
Average	25.0%		35.3%	36.7%		34.7%	36.6%		47.1%	44.8%		

first year; 53 patients in Group II, of whom 16 (30 per cent) had recurrences in the first year, and 10 patients in Group III, 6 of whom died in less than one year and one was living in the sixth year.

Rahm's report gives a mortality of 72.5 per cent for the five-year period for cases which did not receive post-operative radiation. He groups the radiated cases as follows:

Died in 1st year after light radiation, 47%; after intermediate radiation, 40%; after intensive radiation, 44.4%.

Died in 2nd year after light radiation, 23.5%; after intermediate radiation, 10%; after intensive radiation, 11.1%.

Died in 3rd year after light radiation, 0; after intermediate radiation, 20%; after intensive radiation, 11.1%.

From a study of the results at the Giessen Clinic, von der Hutten concludes that post-operative radiation does not change the percentage of cures in Group I; that the results in Group II are inconclusive, but that cases in Group III are made worse by insufficient or intensive radiation, and that none of these cases are free from recurrence for more than two years.

Forssell's cases, as reported by Larsen and Lysholm, were treated by small repeated doses of radiation and 60 per cent had lived free from recurrence for three years. Of these cases, 26 were in Group I, 24 in Group II, and 1 in Group III. In 1920 heavy dosage was employed, but the results were inferior, so the intensive radiation was abandoned. Of 33 patients so treated, only 16 lived for one year without recurrence.

Lehmann's report of the results of non-intensive post-operative radiation showed 55 per cent free from recurrences for three years and 39 per cent for five years, as compared with 32 per cent and 28 per cent, respectively, in the non-radiated cases. Among the cases which received intensive radiation, there were recurrences in 47 per cent during the first year, so that the number of recurrences, as compared with non-radiated cases, was already reached. He concludes that no progress has been made in the treatment of breast cancer through the employment of intensive post-operative radiation.

Iselin believes that non-intensive post-operative radiation results in twice as many cures as are found among non-radiated cases. Anschütz says that post-operative radiation increases the percentage of cures from 48.8 and 36.4 per cent for three and five years, respectively, in non-radiated cases; to 60 and 55.5 per cent for three and five years, respectively, in radiated cases.

J. de Smit reports that among 104 cases of breast cancer treated between 1918 and 1921, 60 cases received intensive post-operative radiation. Among these there were glandular metastases in 27 per cent, as compared with 29 per cent among the non-radiated cases. Other metastases developed in 19 per cent of the radiated cases and in 20 per cent of the non-radiated cases.

C. Linder reports that among 101 cases treated between 1918 and 1922, either with small repeated doses or with doses of medium intensity, 58 per cent had recurrences in one year and 42 per cent were free from recurrences for three years.

At a meeting of the American Surgical Association, at Washington in 1921, there was a discussion on the treatment of breast cancer. The papers read at that meeting were surgical and gave no statistical studies of the results of radiation. In the discussions the opinions as to the value of radiation were somewhat divided. Lee stated that at one hospital, among 30 cases which were operated upon, 8 received post-operative radiation; the 22 non-radiated cases lived six and one-half months without recurrence and the 8 radiated cases lived seventeen and one-half months.

As is shown by our Tables (VI-VIII), post-operative radiation has not improved the condition of our patients. That intensive radiation is distinctly harmful is shown by Table V, in which it will be noted that the percentage of recurrences in the first year has already reached as large a percentage as that which is attained after surgery alone in three years. Since recurrences do develop after post-operative radiation it is evident that all malignant cells have not been eradicated by the operative procedure. It has not been satisfactorily proven that radiation actually stimulates malignant cells to activity. It seems reasonable to assume that the early appearance of a recurrence after post-operative radiation may be due to the lowering of

TABLE VI

RESULTS OF RADIATION PLUS OPERATION

(Cleveland Clinic Series)

Survival period	Living, without recurrence	Living, with recurrence	Dead, without recurrence	Dead, with recurrence	Dead, cause unknown
Light Therapy—Number Treated 92					
Less than 3 years...	39.1%	13.0%	1.0%	23.9%	7.6%
3 to 5 years.....	26.0	5.4	0.0	4.3	3.3
5 or more years....	9.8	1.0	1.0	6.5	0.0
Intensive Therapy—Number Treated 74					
1st year	63.4	32.3	0.0	4.0	5.4

(Dec. 10, 1924)

TABLE VII

COMBINED TABLES—RESULTS OF TREATMENT ACCORDING TO PERTHES' GROUPS

(Cleveland Clinic Series)

	Group I Non-radiated 345 cases 1-3 years	Group III Light radiation 92 cases 1-3 years	Group IV Intensive radiation 74 cases 1 year
Living, no recurrence	39.1%	39.1%	59.4%
Living, with recurrence	14.0	13.0	31.0

(Dec. 10, 1924)

TABLE VIII

RECURRENCES IN FIRST YEAR AFTER POST-OPERATIVE RADIATION

(Cleveland Clinic Series)

	Group I Non-radiated	Group II Light radiation Insufficient	Group IV Intensive radiation
Recurrences, 1st year	16.5%	29.3%	35.1%

(Dec. 10, 1924)

TABLE IX

RESULTS IN THE TREATMENT OF RECURRENCES

(Cleveland Clinic Series)

No. of Cases	Method of treatment	Living less than 3 years	Living from 3 to 5 years	Living more than 5 years	Died in less than 3 years	Died in 3-5 years	Died after 5 years
62	By surgery alone	30.6%	8.0%	9.6%	43.5%	3.2%	4.8%
25	Surgery and X-ray	32.0	4.0	8.0	44.0	12.0	0.0
14	X-ray alone	50.0	0.0	7.1	42.8	0.0	0.0
12	Other methods	91.6	0.0	0.0	8.3	0.0	0.0

(Dec. 10, 1924)

the local and organic resistance of the patient by the recent severe trauma of the operation. In addition, the radiation of a large blood volume, as is necessary in prolonged radiation of the chest, no doubt plays an important rôle in diminishing resistance.

PRE-OPERATIVE RADIATION

Pre-operative radiation is advocated by Lee, Pfahler, Holmes, Christie, Boggs, Stone, Hernaman-Johnson and many others, who have found it to be a justifiable procedure. I think none of these would advocate pre-operative radiation to the exclusion of post-operative treatment, but the combination of both would probably be their method of choice. Theoretically, radiation should be as valuable before as after operation and the combination would seem to be a solution of some of our problems. Unfortunately, this method has not been adopted by many roentgenologists or surgeons, though it is not a new combination of methods; but most cases that have been so treated are far advanced, so that there are no available statistics from which to judge its efficacy. Coventry gives the results of his experience with pre-operative plus post-operative treatment, but the time interval is not stated. He states for his

associates and himself that the presence of involved axillary glands has not deterred them from advising operation and that among 89 per cent of their cases which had axillary involvement, 80 per cent received pre-operative radiation; among the latter, 70 per cent showed no recurrences in the involved axilla; of those with metastases in the supraclavicular glands there were primary metastases in 11 per cent and recurrences in 0.5 per cent, and local skin recurrence occurred in 2.8 per cent. Sittenfield has treated 15 cases pre-operatively, with no recurrences.

Lee's experience with pre-operative plus post-operative treatment is satisfactory. He reports that among 54 primary inoperable cases treated before January, 1921, 10 were alive and four of these presented no evidence of disease. Neuman, Sluys and Coryn report an interesting pre-operative-post-operative technic by high voltage, the treatment being given daily for ten days, this being followed in two months by another complete cycle of radiation. In four years they have treated 40 cases, with two deaths from the primary growth and four from recurrence or metastases.

RADIATION ALONE

The reports of cases treated by radiation alone are necessarily very meager, as surgeons do not refer these cases to the radiologist unless there is some contra-indication to operation.

König treated 17 cases in Group I by intensive radiation alone, with only two cures.

Nordentoft treated 42 cases, of which 5 operable cases lived from six to eight years and 2 for from three to four years; 2 recurrent cases lived from two and a half to three and a half years.

Sittenfield treated 8 inoperable cases with extensive glandular involvement; of these, 2 were rendered operable and of the remaining 6, 4 were living after fourteen months, 3 after from six to eight months.

A. Beck reported the treatment of 15 cases of inoperable cancer, among which 4 were living, but of the other 11 only 2 showed slight improvement.

For our own series the number of recurrences occurring in the first year are shown in Table IX, from which it appears that fewer recurrences follow surgery alone than follow either light or intensive radiation. It should be stated, however, that a large percentage of the cases in Group II which received light radiation were unfavorable cases, not all of which were treated at this clinic. Many were insufficiently radiated and most of them were distinctly unfavorable cases. All the cases in Group IV which received intensive treatment have been treated at this clinic.

Holmes reports a small group of cases involving glands in the axilla and above the clavicle that were not operated upon, but treated by roentgen ray alone, and states that these cases certainly have done much better than similar cases in which operation was followed by radiation.

Of all cases treated by Opitz by radiation alone, 19.6 per cent were free from recurrences for three years. We have treated only three operable cases by radiation alone after operation was refused and they have remained well, one for over three years, one for two years and one for one and one-half years. However, none of these have thus far lived for the full term of their natural expectancy of life.

As stated above, the cases usually treated by radiation alone are far advanced and inoperable, so that this is a poor group from which to draw conclusions as to the value of radiation. These patients have usually already had the disease for the full period of the average life expectancy and their resistance is low. It would seem from the quoted results that these cases are not made worse by conservative treatment and that they receive a certain degree of palliation, which makes the procedure justifiable.

That in some cases in the inoperable group the tumor and the involved glands will show a marked reduction is the experi-

ence of every roentgenologist, but there is some doubt as to whether or not they ever actually become operable. I believe that we should not be hasty in recommending operation in these cases until we are reasonably certain that the growth is well under control and actually arrested and that no new metastases are developing in distant areas, as otherwise the operation will be of no avail and the patient will be made distinctly worse.

The treatment of operable breast cancer by radiation alone as a method of choice is certainly not justifiable in the light of the experiences reported. It is illogical on account of the superficial location which does not lend itself to thorough homogeneous radiation. We may attain success in a few cases in which the cancer is particularly sensitive to radiation, but unfortunately the majority of cancers of the breast are not of this type. It is certain that radiation alone can not yet compete with surgery in the curative treatment of early cases of cancer of the breast; and in the treatment of even more advanced cases it is not proven that radiation will give as good average results as are secured by surgery.

THE TREATMENT OF RECURRENCES

A statistical study of the treatment of recurrences is unsatisfactory and the literature is destitute of reports.

In regard to our own series, which are reported in Table IX, it should be stated that it has not been proven in every case that the condition treated was actually a recurrence. The group treated by radiation alone is too small for comparisons to be of value, but, nevertheless, it is interesting to note that the percentage of those who died in less than three years after treatment by radiation is high and that there is a fairly large percentage of patients who have lived for from three to five years and more after treatment by surgery alone. Most of the cases included in the group treated by radiation were inoperable, and this group includes some cases with metastases, while the groups treated by surgery are entirely composed of cases with local or glandular recurrences.

Although all of these groups are too small for any conclusions to be drawn at this time, nevertheless we have noted that the intensive radiation of a local recurrence has not proven to be as valuable as lighter treatments. We have treated a few cases by radium packs or by implantation of emanation seeds with fairly satisfactory results.

The radiation of metastases in the lungs is justifiable and relieves the dyspnea and pain. Metastases in the bones are not curable, but palliative treatment is beneficial as it relieves the pain. It is interesting to note that new bone may develop and frequently life is comfortably prolonged, but the patient eventually succumbs.

We feel that there is a distinct danger in "cross-fire" radiation into the normal lung by the high voltage method. We had the misfortune of producing pneumofibrosis in four of our earliest cases which were so treated, and have abandoned this method. It is only reasonable to suppose that the lung, which is full of end-arteries and lymphatics and terminal bronchioles with their susceptible endothelial cells, will be enormously affected by large doses of radiation. This danger has been pointed out by Groover, Christie and Merritt, Rose, Hines and many others, and is now fairly well understood. Our cases, which, as shown by radiographs taken prior to treatment, were all free from pulmonary metastases, developed difficulty in breathing and a dry cough within about three weeks after radiation. In these cases the difficulty in breathing is most marked on exertion and is attended with pain in the chest of a constricting nature. Later there are evidences of fluid and of consolidation which begins at the base and extends gradually upward. Of our four cases, two died in about three months, one died with metastases to the spine, the pelvis and the lungs,

and with nodules of malignancy in the fibrosed lungs, and one is living and gradually improving after an exceedingly stormy time which lasted for a year.

BIOLOGICAL CONSIDERATIONS

Until within the last few years radiation therapy was entirely empirical, but within the last five years it has been placed upon an increasingly firm physical and biological foundation. We are now able to measure the wave lengths and the intensity of radiation by comparatively accurate methods, and apparatus is built to deliver larger intensities under constant conditions.

Our knowledge of how or why roentgen rays produce biologic (or physical) reactions is still based upon certain theories, chief among which are the following: (1) the theory that the energy of the secondary beta rays produces such effects or chemical changes as ionization of the component parts of the cell, and (2) the point heat (Dessauer), or quantum theory, that the effect is due to the production of a sufficient amount of energy at one point to cause destruction of the cell.

The biologic basis for the radiation treatment of breast cancer or of any malignancy may be said to be based upon the experimental evidence obtained by Colwell and Russ, Wood and Prime, Wedd, Chambers, Hussey, Nogier, Jeaubert de Beaujeu, Centanni, Nakahara and Sturm and many others who have shown that a sufficient irradiation of malignant cells causes their devitalization, so that when transplanted they are unable to develop. On the basis of their microscopic observations, Alter, Ewing, MacCarty and others agree that cells that are radiated undergo nuclear fragmentation, vacuolization, hyalinization and fibrosis and there is lymphocytic infiltration that may be due either to the direct effect of radiation or to natural efforts to surround the devitalized cells. The entire process has been thought to have the effect of obstructing and obliterating end-arteries and lymphatics, the endothelial cells of which are particularly susceptible to the effects of radiation.

The assumption that the end-arteries and lymphatics are obstructed is denied by Wood, who has been unable to produce this effect experimentally in normal tissues. He also states and Murphy has proven that tumors will grow in previously radiated areas, in spite of the general belief and experimental evidence to the contrary. This assumption is supported clinically by the development of recurrences in thoroughly radiated breast areas.

Because of the fact that malignant tissues are known to be susceptible to radiation, radiation should help to prevent the growth of cells and their dissemination, whether or not the "lymphatic" or the "embolic" theory of dissemination of malignancy is accepted. That there is a normal organic resistance to the development of malignancy is universally believed and trauma from operative procedures or from too intensive radiation may break down this resistance.

When we treat breast cancer post-operatively we hope to devitalize malignant cells that may have been missed at operation. It is true that cancer cells may lie dormant for long periods of time after any method of treatment, as is shown by the development of late recurrences and by the fact that malignant cells which must have remained localized for many years after treatment are sometimes found at autopsies on patients who have suffered from cancer but have died of some intercurrent disease.

By pre-operative radiation we attempt to devitalize cancer cells as well as to create a resistance in the surrounding tissues which will make it more difficult for the already devitalized malignant cells to grow if they should be transplanted or disseminated by the operative procedures. This condition is thought to be brought about by a devitalization of the malignant cells and an obliterative effect upon the end-arteries and lymphatics as the result of the radiation.

The effects of radiation do not take place immediately and the microscopic effects are not noted until from at least forty-eight to seventy-two hours after radiation; they are then progressive and reach their maximum in about two to three weeks. That this period of delayed action, which may be called the "radiation latent period," exists, is demonstrated by the fact that erythemas do not begin to develop for some time after radiation.

In the light of our knowledge of the latent period it would seem logical that a sufficient time for the maximum reaction to develop should elapse between the pre-operative treatment of a cancer and operation. A delay is necessary also to allow the patient to recover completely from any ill effects of radiation before undergoing operation. Wood advocates operation within forty-eight hours after radiation, which would appear to cause the height of the radiation reaction to occur during the time when wound healing is taking place and the resistance of the patient is at a minimum.

The following objections to pre-operative radiation are raised by surgeons:

First, that wound healing is interfered with. This may be true if the healing and radiation reaction are coincident. However, in a few cases in which we have used this procedure we have not encountered this difficulty.

Second, that there is excessive bleeding. This has not been the usual experience of our surgeons nor have our operations been made more difficult, provided an excessive dosage is not given. If the procedure is of value, that is, if the patient receives ultimate benefit, then any increased difficulty of operation which does not endanger the life of the patient should receive little consideration.

Third, that metastases may develop during the short period before the operation. This would actually occur in very few cases and in all probability such metastases already existed undiscovered. It is the experience of every roentgenologist that tumors and glands are reduced so that their growth is at least arrested and metastases probably prevented. Surgeons not infrequently see metastases develop immediately after purely surgical procedures.

Fourth, that patients do not return for operation if their condition is improved by radiation. This means lack of co-operation between the patient, the surgeon and the radiologist. The radiologist should know that he can not hope to give the patient as much benefit as the surgeon, and both the radiologist and the surgeon must make the patient understand that operation is necessary.

Prior to the installation of a high voltage apparatus two years ago, we treated breasts post-operatively with small dosage, usually using about 90 K.V. and 4 mm. of aluminum, and dividing the chest and back into six areas, each area being treated once a week until a slight erythema was produced, followed by moderate tanning. With the heavily filtered high voltage we used copper filters of 0.5, 0.75 and 1.0 mm. on 200 K.V. and gave an erythema dose, this dose being repeated as soon as the skin was in condition, say, in three months and again six months later. We have felt that by these intensive dosages there has been a higher percentage of recurrences than by the old method of small dosage. We have not tried building up with artificial media, as has been advocated for the purpose of increasing the scattered radiation, as we believe that no matter how the radiation is administered no more can be given than the skin will tolerate, viz., 100 per cent E.S.D., and that, therefore, it is physically impossible to administer a so-called carcinoma dose into the breast area after operation.

The recent experiments of Wood have shown that it is necessary to give five or six erythema skin doses to malignant tissues in order to destroy them and that "within practical limits of wave length there is no difference in the lethal effect on tumor cells of long or short wave length, provided equal quantities are employed."

If it is necessary to administer a minimum of five erythema doses to destroy Wood's mouse tumors, it is obviously impossible to deliver this huge dose into human breasts, even allowing for a possible high variation between human and mouse tumors.

The effective treatment of breast cancer, as well as of other malignancies, depends upon the further development of technic. From a study of our previously quoted statistics it must be concluded that intensive post-operative radiation is not the proper technic and that our previous method of less intensive repeated dosage gave better results. The work of Kok and his co-workers is of interest in that it corroborates the results obtained by Wood; but he has also found that the optimum dose to cause regression of a certain tumor of mice is 200 to 225 E. (1,700 being equivalent to an E.S.D. in humans), and that lower and higher doses have less effect. He has found, further, that a similar favorable effect is gained by 25 per cent of this dose distributed over the whole body of the animal. He believes that there is no so-called carcinoma dose in the sense of the direct destruction of cancer cells, but that the main rôle of radiation is an indirect effect produced in the organism as a whole. There is a lethal dose of radiation for a mouse and this dose is larger for mice with malignant tumors than for normal mice.

Régaud has long contended that the best effects are attained by extending dosage over a longer period, thus obtaining radiation during mitosis of the malignant cells and while they are most sensitive.

Clinically and experimentally it has been proven that there is an optimum dose for the radiation of patients with malignancy, and radiologists must endeavor to develop their technic to correspond to the various types of malignant disease. It is doubtful whether the effort actually to destroy all malignant cells within a certain area and in a short time will prove to be the entire solution of the problem. To increase or preserve the natural resistance is absolutely essential, and over-radiation, therefore, is at least as deleterious in its effect as insufficient radiation.

CONCLUSIONS

1. Some classification for studies of breast cancer should be universally adopted.
2. Studies based upon three-year "cures" are of no comparative value.
3. Post-operative intensive radiation, especially when administered in large doses, is hazardous and increases the percentage of recurrences and metastases.
4. Since it is recognized that radiation may devitalize or destroy certain malignant cells radiologists must study the technical problems involved in the administration of X-rays in order to determine the most advantageous methods for their application to breast cancer.
5. The natural resistance of the patient must not be destroyed but must be enhanced.

BIBLIOGRAPHY

ANSCHUTZ: Ueber Erfolge der Roentgennachbestrahlung radikal operierter Mammakarzinome. Muenchen. med. Wchnschr., 1921, LXVIII, 191.

ANSCHUTZ and HELLMANN, J.: Ueber die Erfolge der Nachbestrahlung radikal operierter Mammakarzinome. Muenchen. med. Wchnschr., 1921, LXVIII, 1005-1007.

BECK, A.: Zur Roentgenbehandlung des Mammacarcinoms. Arch. f. klin. Chir., 1924, CXXIV, 194-202.

BOGGS, R. H.: Ante-operative radiation of carcinoma of breast. Am. Jour. Roentgenol. and Rad. Ther., 1922, IX, 508-513.

CHRISTIE, A. C., MERRITT, E. A., and GROOVER, T. A.: Intrathoracic changes following roentgen treatment of breast carcinoma. Am. Jour. Roentgenol. and Rad. Ther., 1923, X, 471-476.

COLWELL, H. A., and RUSS, S.: Radium, X-rays and the Living Cell. London, 1924.

COVENTRY, W. A.: Metastasis in breast cancer. Minnesota Med., 1924, VII, 182-186.

EWING, J.: Neoplastic Diseases. Philadelphia, 1922.

FITZWILLIAMS, D. C. L.: On the Breast. St. Louis, 1924.

HAGGARD, H. W., and DOUGLASS, H. L.: Tumors of the breast. Jour. Am. Med. Assn., 1923, LXXX, 445-448.

HERNAMAN-JOHNSON, F.: On the value of combined treatment, with special reference to surgery, electricity and X-rays. Arch. Radiol. and Electrother., 1919-20, XXIV, 325-333.

HINES, L. E.: Fibrosis of lung following roentgen-ray treatments for tumor. Jour. Am. Med. Assn., 1922, LXXIX, 720-722.

HOLFELDER, H.: Der gegenwartige Stand der Strahlen-

behandlung des Brustkrebs. Med. klin. Wchnschr., 1925, XXI, 213-216.

HOLMES, G. W.: Present status of X-ray therapeutics. Am. Jour. Roentgenol. and Rad. Ther., 1921, II, 522-527.

VON DER HUTTEN, F.: Dauerheilung des operierter Brustkrebses mit und ohne prophylaktische roentgenstrahlung. Muenchen. med. Wchnschr., 1922, LXIX, 13-14.

ISELIN, H.: Der pathologisch-anatomische Befund als Prognostikum für den Brustkrebs. Schweiz. med. Wchnschr., 1920, I, 23-36.

JUNGLING, O.: Das Mammacarcinom und seine zeitgemässe strahlentherapeutische und chirurgische behandlung. Klin. Wchnschr., 1924, III, 1077.

JENKINSON, E. L.: Roentgen treatment of breast carcinomata. Radiology, 1924, II, 151-155.

KASTNER, H.: Zur prophylaktischen Roentgenbestrahlung radikal operierter Brustdrüsenkrebse. Beitr. z. klin. Chir., 1921, CXXI, 413-423.

KOK, F., and VORLAENDER, K.: Biologische Versuche ueber die Wirkung der Bestrahlung auf das Karzinom. Strahlentherapie, 1923, XV, 561-604.

KONIG, F.: Betrachtungen ueber die Behandlung des Brustkrebses. Ztschr. f. Geburtsh. u. Gynak., 1924, LXXXVII, 270-277.

LANE-CLAYPON, JANET E.: Cancer of the breast and its surgical treatment. Repts. on Pub. Health and Medical Subjects, No. 28, London, 1924.

LARSEN, T., and LYSHOLM, E.: To the question of post-operative treatment of mammary cancer. Acta radiol., 1924, III, 8-14.

LAZARUS-BARLOW, W. S., and LEEMING, J. H.: Natural duration of cancer. Brit. Med. Jour., 1924, II, 266-267.

LEE, B. J.: Radiation in the treatment of mammary carcinoma. Canad. Pract. and Rev., 1924, XLIX, 141-147.

Results of treatment by radiation of primary inoperable carcinoma of breast. Ann. Surg., 1923, LXXVI, 359-385.

LEE, B. J., and HERENDEEN, R. E.: Treatment of primary inoperable carcinoma of breast by radiation. Radiology, 1924, II, 121-136.

LEHMANN, J. F.: Weitere Beobachtungen ueber die post-operative prophylaktische Bestrahlung des mammakarzinoms. Zentral. f. Chir., 1924, LI, 262-264.

LINDENBERG, H.: Zur Statisik der operativen Dauerheilungen des Mammacarcinoms. Deutsche Ztschr. f. Chir., 1914, CXXVIII, 156-182.

LINDER, C.: Resultate der postoperativen Roentgenbestrahlung der Mammakarzinome. Deutsche Ztschr. f. Chir., 1924, CLXXXV, 385-394.

LOOSEN, H.: Unsere postoperativ bestrahlten Fälle von Brustkrebs. Muenchen. med. Wchnschr., 1921, LXVIII, 518.

MERRITT, E. A.: Recent experiences in the treatment of mammary carcinoma by means of heavily filtered X-ray. Jour. Radiol., 1922, III, 373-375.

MOSCHOWITZ, A. V.: *Discussion* of papers on End-results of Carcinoma. Tr. Am. Surg. Assoc., 1922, XL, 143.

MURPHY, J. B., HUSSEY, R. G., and STURMS, E.: Studies on X-ray effects. VI. Effect of cellular reaction induced by X-rays on cancer. Jour. Exper. Med., 1921, XXXIII, 299-313.

NEUMAN, SLUYS and CORYN: Radio-surgical technique in cancer of the breast. Am. Jour. Physical Therap., 1924, I, 417-418.

NORDENTOFT, S.: Roentgenotherapy in mammary cancer. Ugesk. f. Læger, 1922, LXXXIV, 1300-1329.

OPITZ, E.: Irradiation of cancer. Klin. Wchnschr., 1923, II, 2232-2233.

Principles of radiotherapy of carcinomata, especially of uterine and mammary carcinomata. Am. Jour. Roentgen. and Rad. Ther., 1923, X, 312-319.

Welche Vorstellungen sind heute ueber Enstehung und Heilbarkeit des Krebses erlaubt? Muenchen. med. Wchnschr., 1924, LXXI, 668-671.

PERTHES, G.: Erfolge der Brustkrebsbehandlung vor und nach Einfuehrung der prophylaktischen Roentgenbestrahlung der operierten Fälle. Zentralbl. f. Chir., 1920, XLVIII, 25-29.

PFAHLER, G. E.: Radiotherapy in carcinoma of the breast. Surg., Gynec. and Obst., 1922, XXXV, 217-226.

RAHM, H.: Zur Frage des Nachbestrahlung operierter Mammacarcinome. Beitr. z. klin. Chir., 1924, CXXXI, 716-719.

RODMAN, M. L.: Diseases of the Breast. Philadelphia, 1908.

ROSE, C. B.: Breast carcinoma treated surgically and by roentgen ray. Jour. Am. Med. Assn., 1923, LXXX, 1750-1754.

SALTZSTEIN, HARRY C.: The prognosis in cancer of the breast. Am. Jour. Med. Sci., 1923, CLXV, 424-430.

SISTRUNK, W. E.: Cancer of breast. Journal-Lancet, 1922, XLII, 75-81.

SISTRUNK, W. E., and MACCARTY, W. C.: Life expectancy following radical amputation for carcinoma of breast. Ann. Surg., 1922, LXXV, 61-69.

SITTENFIELD, M. J.: Does radiation enhance post-operative recurrence of carcinoma of breast? J. Radiol., 1922, III, 476-478.

DE SMIT, J.: Mammary cancer and post-operative irradiation. Nederlandsch Tijdschr. v. Geneesk., 1923, I, 1425-1428.

STONE, W. S.: Present field for use of X-rays and radium in malignant neoplasms. Am. Jour. Roentgenol. and Rad. Ther., 1922, IX, 502-507.

TICHY, H.: Der Einfluss der Roentgennachbestrahlungen auf die Heilerfolge der Operation des Brustkrebses. Zentralbl. f. Chir., 1920, XLVII, 470.

WALTHER, H. E.: Die Roentgenbehandlung des Brustkrebses. Schweiz. med. Wchnschr., 1923, LIII, 747-752.

WILLIS, G. S.: Radium in carcinoma of the breast; a necessary pre-operative routine. New York Med. Jour., 1923, CXVII, 453-457.

WOOD, F. C.: Effect on tumors of radiation of different wave lengths. Am. Jour. Roentgenol. and Rad. Ther., 1924, XII, 474-482.

The experimental pathology of cancer. Jour. Am. Med. Assn., 1925, LXXXIV, 4-8.

WOOD, F. C., and PRIME, F.: Lethal dose of roentgen rays for cancer cells. Jour. Am. Med. Assn., 1920, LXXIV, 308-312.

DISCUSSION

DR. R. E. HERENDEEN (New York): It is certainly very refreshing, in listening to a paper on roentgen therapy in cancer and especially of carcinoma of the breast, to hear statistics presented. I feel that we are all much indebted to Dr. Portmann for this excellent and thorough presentation. It sounds so reasonable and it is so thoroughly in accord with our experiences at Memorial Hospital that it is difficult to find

any point on which to disagree with him. In the matter of statistics, however, it seems that his surgical figures are at least as favorable as he could possibly make them. They no doubt include many cases of relatively benign types of tumors. In a recent paper by Dr. Lee and myself, which was read at Washington a short time ago, we were able to compare some of our results with a series of cases treated by surgery alone. This group of surgical cases consisted of something like 25 per cent, I believe, who were alive at the end of three years, and in this group of cases there was none of the so-called relatively benign type included; all the tumors were highly malignant or moderately malignant, so that in comparing our groups, that is, the cases treated pre-operatively and post-operatively, with the surgical group and with the group treated only post-operatively, we rejected any case that appeared to be relatively benign in character; so our figures are, perhaps, for that reason, somewhat lower than those presented by Dr. Portmann. There were alive, at the end of three years, 25 per cent, I believe, of the surgical cases. In our post-operative group we found something like 33 to 35 per cent alive for this same period of time—that is, in the group having only post-operative radiation. In the groups radiated pre-operatively and post-operatively also, we found that there were 45 per cent—perhaps a little over—alive at the end of three years' time. None of these cases was treated with the high voltage technic; all received what Dr. Portmann described as the lighter type of therapy. We have not used the massive dose high voltage therapy methods in treating any of our cases of carcinoma of the breast, excepting in a few instances where inoperable cases were submitted for treatment, and lately in a few selected cases of primary operable carcinoma. And here I wonder if I am correct in stating that Dr. Portmann finds that there is very little justification for the use of radiation alone in primary operable carcinoma of the breast? It is hard to believe that results can be so definitely improved by the use of radiation in conjunction with surgery without feeling that in at least some carefully selected cases it can be expected to yield as good results as when employed alone. It is true that we have no figures available as yet, but there is enough evidence, at least, to warrant selection of a fair number of cases for treatment by radiation alone, and by radiation I mean X-ray therapy combined with radium. In a group of inoperable carcinomas of the breast, treated by radiation alone, we were able to find 17 per cent alive at the end of three years, which is almost as good as is frequently obtained by surgical treatment of primary operable carcinoma of the breast. I believe that the next step is in that direction,—treatment of primary operable carcinoma of the breast by radiation alone.

Dr. Emil G. Beck (Chicago): It is evident from the statistics that radiation alone has not very much improved the final result in carcinoma of the breast. The medical profession has attacked the problem in three different ways: The first is to recognize the disease early; the second to improve the surgical treatment, and the third to perfect radiotherapy. The surgeons, of course, have about reached the limit in the radical operation of carcinoma of the breast, except that too few radical resections of the shoulders are practised in far advanced cases. My brother Carl reported, some eight years ago, seven cases in which he removed the entire shoulder girdle in practically hopeless cases, and three of them have been shown only a year ago in Chicago, still without recurrence, so that we do not have to be so pessimistic about the subject of carcinoma of the breast. You also know that the superficial or exposed carcinomata yield better results than those that are deep under the skin, as carcinoma of the breast. Our death-rate is not so much from the surgical mortality, even in the extensive operation—that is almost negligible—but it is the recurrence which

gives these unfavorable prognoses. Now since it is proven that the exposed carcinoma is more amenable to the treatment, I have, in the past ten years, employed a method which has increased our good results; namely, the exposure, rather the removal, of the tumor. The growth is either completely or only partly removed, leaving the wound open for subsequent radiation treatment. I have recently read a paper before the Surgical Society of Chicago on carcinoma of the breast, and I am familiar with all the figures here given because I have gone over the subject. I hope you will not think it is too boastful when I say that in the last five years, of all the cases I have operated on for carcinoma of the breast and left open, only one, so far, has had a recurrence. I must, however, explain that I have divided my material into two groups: The first group consists of ten cases which have not been operated on before; the second group, of fifteen cases, in which an operation had been performed elsewhere and a recurrence had taken place,—usually the supraclavicular area was involved. Of the latter fifteen patients, all except one have died; that one, still living, has had a complete resection of the shoulder. Of the first group there is only one who has had a recurrence, a woman who was reported two years ago. I removed the left breast, and she now has a recurrence in the right lung.[1]

Now, what is the lesson to be learned from this? It is contained in the last sentence the doctor spoke, that to obtain results we must improve the post-operative treatment with radiotherapy. If it is true that massive doses, large enough to destroy the cancer, injure the normal cells surrounding the growth, we must find a means by which this can be prevented. This may be done by exposure of the growth, its removal when possible, and exposing the open wound to radiation, either X-ray or radium. This will prevent toxemia, because the dosage of radiation may be reduced to either one-fifth or one-tenth of the dose required in the case where the overlying structures are to be protected. Of course, the time is too short since we have started the use of this method, to give statistics, but it has been extended to all varieties of cancer cases, not only those of the breast, and the results are practically the same.

[1] Since the date of the discussion (May, 1925) this patient has died.

Dr. B. J. Lee (New York): I am not as optimistic as Dr. Beck about carcinoma of the breast. The statistics are very confusing. Recently some Cornell students, who were having a little course with us at Memorial Hospital, were asked to look up some literature on carcinoma of the breast and its surgical treatment. One of the articles they brought back showed 46 per cent of five-year cures. This particular article I have analyzed very carefully, and it is incorrect in its figures. The total number of cases in the whole report was about 116; many of them 1, 2, 3, 4 and 5 year cases, but in the conclusion of the article the five-year results were given as 46 per cent. Now I am much more pessimistic about the whole subject than most of my surgical friends, and I am a surgeon. We went over very carefully a series of cases at New York Hospital last year, all cases that had been admitted there from 1913 to 1919, —five-year results. All the pathology was checked; all cases proven. We had exactly 15 per cent alive at the end of five years. Some years prior to this report, Dr. Finney reported 17 per cent as a reasonable figure, and I think he was nearly correct. I do not believe that true carcinoma of the breast, surgically well treated, will give 38 per cent and 40 per cent of three-year cures. Now I believe that in many clinics, cases are padded into the carcinoma of the breast record which are not true carcinoma of the breast at all. I have at the present time, under my personal direction, three cases in which the pathologists rendered reports, microscopically, of carcinoma of the breast. The cases were gone over carefully, with one or two of our pathologists,

and we felt from a pathological standpoint and certainly from a clinical standpoint, that the cases were not true carcinomata, and they were not included in that group. There are many cases of chronic mastitis with a little proliferation, slight overgrowth of epithelium, beginning in malignancy. Those cases are not cancer, but they go into the cancer group. I think you have to revamp your whole notion of this subject and begin again; you have to try to find out what is true carcinoma of the breast in the moderately and highly malignant group. Now adenocarcinoma of the breast is not carcinoma of the breast of a moderately or highly malignant type; it will do well by many means of treatment, even local excision in many of these cases will give you a 100 per cent result. Dr. Greenough reported how struck he was by cases that had done so well by local excision. They seemed benign before operation.

As to pre- and post-operative radiation, I have not at all the impression that pre-operative or post-operative radiation is not valuable. Dr. Herendeen and my associate, Dr. Adair, at the Memorial Hospital, have gone over cases carefully, and we have found a striking improvement in cases radiated properly and carefully by the low voltage method after operation, after a well-done operation; and, as Dr. Herendeen has told you, the comparison is most striking, including all cases in the group. We can give only three-year results because we have no dependable data prior to April 1, 1919,—pre-operative data. We ended our report at April 1, 1922, and it gave us three-year results. Up to April 1, 1925, when we included all our cases, we had 52 per cent alive in the pre-operative and post-operative surgical groups; 38 per cent alive in the post-operative group, and 24 per cent alive in the surgical group. All are comparable cases, well checked, pathologically. When we excluded the relatively benign cases, there were more of these in the radiated group than in the surgical group; it still showed 46 per cent for the pre-operative, 43 per cent for the post-operative, and 21 per cent for the surgical. Those cases are well studied and carefully gone over and there is no hiatus in our information, so I feel that we have some data in that study which are very important, very impressive and highly suggestive, so that personally I am enthusiastic about the possibilities of pre- and post-operative radiation.

Dr. Clark D. Brooks (Detroit): I was first tempted to advise X-ray treatment about fourteen years ago, on a cancer of the breast which had been excised locally elsewhere. Four months later, the patient presented herself with a mass in the axilla as large as the fist. I advised X-ray treatment, which was given by Dr. P. M. Hickey. The mass disappeared almost entirely, and the patient lived about two and a half years, and then had a recurrence and died suddenly from cancer of the lung. Since that time we have advised the X-ray as a routine post-operative treatment, and for five years, until the advent of the deep ray, advised pre-operative treatments. We had a number of cases of recurrence, which was enough to tell me the X-ray was of very great value pre-operatively and post-operatively. Statistics mean nothing at all when you do not consider, first of all, the age of the patient, how long the carcinoma has been in the breast, and many factors of relative malignancy. In a large city, the very bad cases come to a surgeon, not to a clinic, and a large number have had expectant treatment but no diagnosis. When we see cases with glands on the axilla that are demonstrated before operation by palpation, those cases are inoperable as far as surgery alone is concerned.

I believe it is questionable if the surgeon has the right to treat cases of marked and known cancer without pre-operative X-ray treatment and good surgery and plenty of it, and then as soon as the patient's condition is suitable she should have post-operative treatment. Any statistics brought from clinics where the age limit is not considered and where the glands at the axilla at the

time are not considered, are worthless. Every surgeon knows that he cannot tell before the operation whether or not there are enlarged axillary glands. We find enlarged glands in the axilla as large as hazel nuts, under the clavicle, which were not suspected. We have had only one case in the last fourteen years of local recurrence after operation of the breast, where the patient submitted to post-operative therapy; when, before the X-ray was used, recurrences were common, at times coming within three months, at times at the site of silk worm sutures. Now that the deep X-ray is available, I believe the tendency is to give larges doses than is necessary, and I venture to state that within the next two years the dosage will be lessened.

Dr. B. F. Schreiner (Buffalo): I just want to say a few words in regard to high voltage X-ray in cancer of the breast. Our experience in Buffalo has been that we have accumulated in the last five years about 600 recurrent cancers of the breast, which are the end-results of numerous operations, some of which probably were done when they should not have been. The thing that strikes me very forcibly is the amount of lung involvement and mediastinal involvement, to say nothing of the local recurrences. Now our experience has been, in the use of high voltage X-rays, that formerly, where we deliberately took a patient and rayed her through and through from the anterior side to the posterior in the hope that we could deliver to the tumor and metastases 90 to 100 per cent of the skin dose, she was made worse; she died after a few weeks or months. That brings up the question of the amount of radiation absorbed in the body. Is it necessary to use great distances in using high voltage X-rays, so that you will have a 50 per cent depth dose in the lung where you do not want it? You probably want it in the first three, four or five centimeters of tissue. Most of your doses, as a result, have correspondingly increased, shortening the distance from 80 to 45 centimeters, in laying out a plan of treatment over a period of ten to fifteen days, giving in that time 125 to 150 per cent of the skin dose, keeping down the size of your field.

Now I realize that I have no figures to give you to-day; we are just in the process of collecting them. But I tell you that I have seen primary cancer of the breast which was biopsied, with metastases in the axilla and supraclavicular region, disappear. I have one case which stands out prominently which has now been over three years without any surgery whatever. Recently we have been much gratified in seeing the so-called inflammatory type of carcinoma, that Dr. Lee speaks of, in which there is tremendous swelling of one arm, metastases in the axilla, left and right breast also involved, show regression in a period of six weeks, with divided doses. I would like to see very many of you try a definite plan of adding 25 per cent to 50 per cent, if you stretch your treatment out over a week or two weeks. I personally feel, from what we see, that the surgical treatment of cancer of the breast is not what we are led to believe. A number of years ago I had the pleasant duty of going over the records of 250 cases of two of our prominent men in Buffalo, with the preconceived idea that they had 75 per cent cures for a three-year period. After following the cases up when the returns came in, there were less than 15 per cent that had lived three years. Now I do not think that is anything unusual; probably they operated on cases that to-day you would not operate on, but certainly I am for anything we can do to improve present statistics of cancer of the breast.

Dr. Portmann (closing): I think Dr. Herendeen and Dr. Lee have correctly estimated the situation when they state that the surgical curability of breast cancer is not over 17 per cent. If we study the reported surgical statistics, which express the judgment and experience of a large number of surgeons and include many cases, we must conclude that certainly not over 20 per cent

of all cases are cured by surgery alone. Dr. Brooks points out that we must classify cases according to the age of the patient and we all know the prognosis is less favorable in the younger individuals, but we must certainly classify according to the extent of involvement or type of disease, and it is up to the surgeons to agree upon some one classification to minimize confusion. I suppose that 95 per cent of breast cases radiated, first come to the radiologist after operation, so that he is not prepared to judge in which group any one individual case should be placed.

We have not used Dr. Beck's method of "open wound" treatment. I know that he adopted this technic long ago. I do not know what advantage is offered nor whether one could apply five or six erythema doses into the tissues remaining over the chest after operation.

I do not wish to be understood as saying that radiation has no place in the treatment of breast cancer, because I am sure that it has, but I feel very decidedly that the intensive radiation of the whole chest from front to back and back to front by large fields, as is frequently done, is distinctly harmful. This is borne out by the reports and statistics quoted and by certain of the speakers present.

I believe with Dr. Brooks and Dr. Lee that pre-operative radiation should be the first step in the treatment of a cancer of the breast. Surgeons should recognize this procedure and radiologists must urge radiation before as well as after operation.

It is not rare to observe reduction of breast tumors, axillary and supraclavicular glands following radiation, but if we look farther we find that the malignant cells are not all destroyed but are lying ready to develop. I have had several primarily inoperable cases operated on following this apparent reduction of the glands, and found the malignant tissues still present and probably active, and the patients not benefited.

We can not yet state exactly the results of the treatment of lung metastases because some cases live a year or more untreated, but there is decided relief of symptoms.

In going over the published statistics I endeavored to cover as much ground as possible and to come to some conclusion, because I was astonished to have so many of our cases coming back with metastases or recurrence in the first year after intensive treatment. Of course we can not get recurrences unless some malignant cells remain after operation, but it must also be true that in some instances the resistance of the patient destroys some cells missed by the surgeon. The results reported in my statistics were obtained from the patients of several surgeons all doing about the same type of operation. One must take statistics for what they are worth, but according to my figures and the figures reported by Perthes and others quoted, at least 39 per cent of cases have had recurrence and metastases during the first year after intensive radiation.

I believe that a method such as Dr. Schreiner has outlined, that is, by short focal distance to keep the dose on the surface, is a proper technic.

I can not believe that radiation is the ultimate treatment for operable cancer of the breast, though by combining radium and roentgen ray some advantage is gained. As Dr. Lee points out, if we treat by radiation alone there will be some cases of non-malignant disease reported as malignant, because we can not always be certain that we are treating cancer.

RADIATION TREATMENT OF CANCER OF THE RECTUM [1]

BY THOMAS E. JONES, M.D., Cleveland Clinic, CLEVELAND, OHIO

EDUCATION of the lay public by the American Society for the Control of Cancer has already accomplished much by influencing patients who have benign or precancerous lesions to consult their physicians before the malignant or incurable stage is inaugurated. This is especially true of patients with cancer of the breast. If this propaganda is continued, we may hope that the time will come when the patient who has bleeding from the rectum will think of the possibility of cancer instead of hemorrhoids and will promptly consult his physician, who, in turn, will at once make a rectal examination and as promptly refer the patient to the surgeon or radiologist for immediate treatment.

When a patient is told that he has a cancer he immediately wants to know what his chances are for cure, or, if the condition has apparently progressed beyond the possibility of cure, what will be the probable duration of life and what are the chances for the maintenance of a fair economic status. This is peculiarly the case with carcinoma of the rectum, the subjective discomforts of which increase its terrors. In the majority of cases, even if the condition is operable, the patient is reluctant to undergo the operation because of the resultant physical discomfort, the low percentage of final cures, and the high mortality. If he refuses operation we must offer him some other method of treatment, which, even if its final value has not been established, has nevertheless been sufficiently tested for it to be justifiably recommended. It is obvious that radiation therapy is the only justifiable alternative to surgery in the treatment of malignant disease of the rectum. The success which has attended its application in the treatment of cancer of the cervix has led to its increasing use in the treatment of cancer of the rectum, especially in inoperable and borderline cases, but also in operable cases in which operation has been refused or in bad risk cases. It is not within the scope of this paper to consider diagnostic criteria, the technic of treatment, etc., for time permits only a brief discussion of the general plan of management of these cases and of the present results of radiation therapy as a basis for later comparisons with the results of surgical treatment.

Statistics from many large clinics show that the duration of life in the inoperable untreated cases varies from eight to twelve months. Occasionally a patient will live three, four or five years or even longer, these exceptional cases emphasizing the variations in the resistance of the body to the invading growth, but it is practically impossible to determine clinically what the resistance of any individual case may be. With an average duration of life in the untreated cases of from eight to twelve months, what has surgical treatment to offer in comparison?

According to the published statistics from various clinics the operability varies from 19 per cent, as reported by Boas, to 85 per cent, according to Mills. The Mayo Clinic places the operability at 71.8 per cent. As for the operative mortality, Hartmann collected a series of 1,665 from his own and seventeen other clinics, with an operative mortality of 15.8 per cent for the low operation (perineal and sacral). In 260 operations by the combined abdomino-perineal route the mortality was 37 per cent. Lynch collected a series of 335 cases, with a mortality of 16 per cent. Kraske reports an individual series of 80, with a mortality of 18.7 per cent; Cripps, a series of 85, with a mortality of 4.7 per cent; Bull, a series of 44, with a mortality of 11.4 per cent. At the Mayo Clinic, from 1913 to 1915, the mortality was 12.5 per cent.

[1] Read before the Radiological Society of North America, at Atlantic City, May, 1925.

As for the end-results of surgical treatment, and it is with these that we are here principally concerned, the largest series has been reported by Pennington, who collected the statistics of 1,558 operations by the perineal route, among which there were 258 operative deaths—16.5 per cent; 824 of these patients were followed up, and among them 364, or 44 per cent, had had recurrences. Jones and McKittrick, in a study of the end-results in 116 cases, report 40 per cent of three-year cures from the radical operation. These authors quote the results secured by Miles as 22.7 per cent living at the end of three years and 11.3 per cent at the end of five years. Remington reports 22 per cent well for three years in a group of 218 cases; Lusk reports 16.7 per cent well for three years.

These figures, which show that surgery promises permanent cure only in limited groups of cases, together with the refusal of certain patients to undergo the radical operation, have led to an increasing use of radiation therapy in operable as well as in inoperable cases.

The application of radiation therapy in the treatment of cancer of the rectum has not been employed by a sufficient number of radiologists for a sufficient period, for comparative figures to be of final value. We can only report our own experience up to the present time and that reported in the literature by others.

Kelly has reported a series of 230 cases, among which he had follow-up data in 200 cases. In the total series only six were considered as operable, the remainder applying for radium as a last resort, while 19 were apparently hopeless from every point of view. Eleven per cent of the cases in which end-result data were available had remained well for from one to ten years, 62 per cent had been benefited, and 27 per cent unbenefited. Kelly reports the highest percentage of palliation—68.7 per cent—in the group treated by radium and colostomy. In this group 45 per cent lived for eighteen months or longer. This corresponds with our own experience, 50 per cent of our cases in this group, regarding whom we have final data, having lived for eighteen months or more. Among the twelve operable cases regarding which Kelly had end-result data, five were treated with radium alone and two were cured. In six of these cases operation and radium were used; three of these were cured and one case was not benefited. In his total series of cases treated by radium and colostomy, 6.3 per cent had remained well for one or more years.

Quick has reported the results of radiation in 161 cases of rectal cancer. In practically all of these cases the cancer was well advanced, and he feels that 40 per cent of them should not have been treated at all. Fourteen of these patients remained free from the disease for from four months to four years. Quick advises an exploratory operation to determine whether or not there are distant metastases before radiation therapy is started. He believes that a colostomy should be made only when it is indicated for the relief of obstruction.

May advocates exploration, a permanent colostomy, X-ray treatment four weeks before the removal of the growth by operation, with further radiation six weeks after operation. He claims that metastases yield better to treatment after the removal of the primary growth. He quotes statistics from the Schmieden Clinic for 1919-21, which include 51 cases, 29 operable and 22 inoperable, treated by this combined method, among which 15 cases, or 29.5 per cent, had remained well for two and a half years.

These brief reports from the literature, together with those cited above, do not purport, of course, to be inclusive, but have been selected as representing the present general status of surgery and radiation treatment, on the basis of which, as well as upon our own experience, our present method has been adopted.

During the past four years, of 136 cases of carcinoma of the rectum which have been seen at the Cleveland Clinic, 111 have been treated as follows: 29 by colostomy

only; 14 by colostomy and resection; 8 by colostomy and resection, with radiation, and 60 by radiation. We shall confine ourselves in the main to a discussion of the group treated with radiation alone.

In this group we have follow-up data in 58 cases which number 18 females and 40 males. Of these, three died of intercurrent disease, one of tuberculosis of the lungs, one of apoplexy, and one of angina pectoris. Of the remaining 55 cases, nine have died of the disease and it is known that one has remained well for four years, one for more than three years, five for from two to three years, and eight for one year or more. Among the patients who have died, the duration of life in one case was forty-two months; in one, three years; in four, twenty-six, twenty-four, twenty-three and twenty-one months, respectively, and in ten cases, one year or more. In two cases treated by radiation and colostomy, it was possible to close the colostomy after the patients had remained free from recurrence for eighteen months.

The average duration of life of the patients regarding whom we have ultimate data, *i.e.*, who have died, has been, for the cases treated by radiation, thirteen and a half months, whereas in the cases which were operated upon the average duration of life in the cases in which the radical operation was performed was six months; after colostomy only, five months, and after the radical operation with radiation and colostomy, eleven months.

We have chosen for the above comparison the data regarding the patients who have died, for the reason that, as stated early in this paper, we have been using radiation therapy in an increasing number of cases and, therefore, a sufficient survival period has not elapsed for comparisons of the living patients to be valid at the present time. That radiation with or without colostomy does prolong life, however, is shown plainly by a comparison of the data in the group of cases cited above.

Of practically equal importance to the duration of life is the economic status of the patient after treatment. If he is able to resume his normal activities his economic status is classified as excellent. If the patient can work part of the time, his status is considered as good; as fair if the only improvement is a relief of his symptoms, and as poor if no improvement follows treatment. In these series the economic status of nine patients was classified as excellent; of ten as good; of twenty-two as fair, and of nine as poor. This classification is not made until a sufficient period after treatment has elapsed to make possible a fair judgment as to the degree to which the patient has been able to resume his normal activities.

From the point of view of the patient, another phase of radiation therapy should be considered; that is, the discomfort after treatment as compared with that produced by surgery. There is no doubt that greater discomforts follow radiation. For the first three or four weeks after radiation the patient is fairly comfortable, but thereafter, for a period of three or four weeks, there are usually constant bearing-down sensations, with a desire to go to stool. In certain cases, for some unknown reason, there is a recurrent period of like discomfort three or four months later. The intensity of these post-radiation effects, however, is ameliorated by colostomy.

In general, our present plan of management in all radiated cases of rectal carcinoma is as follows: A colostomy is first made, with an exploration to determine whether or not metastases are present, and their extent. The purpose of the colostomy is to provide the diseased rectum with a period of complete rest, during which irrigations are made. After several irrigations of the distal segment, an examination is made to see if the case is distinctly operable, for this period of rest, which is usually continued for ten days, often changes the picture from one of apparent inoperability to one of operability. If there is any doubt as to the operability, radiation therapy is instituted. Even in operable cases, however, we are now inclined to favor

radiation for the same reason that cases of carcinoma of the cervix are now being subjected to radiation rather than to surgery; radium can easily be implanted in each of these organs and many portals of entry are available for deep X-ray therapy without endangering the abdominal viscera.

Radiation of carcinoma of the rectum, however, is attended by greater technical difficulties, since in this case we are dealing with an organ which is performing an essential physiological function which cannot with safety be interrupted. In this series the location of the growth was low, that is, within easy reach of the finger, in forty-eight cases, and high in ten cases. Only eight of these fifty-eight cases were operable, the average duration of symptoms in the entire series being twelve months.

In each case, from one to four treatments with radium have been administered, not more than two treatments being given in the majority of the cases. The dosage varied from 800 to 4,775 mg. hours, the average case receiving from 2,600 to 3,000 mg. hours in one or two treatments. Twelve cases were treated with both needles and tubes and 48 with tubes alone. Screening varied from 1½ mm. of brass to 1½ mm. of brass plus 1 mm. of lead. In 34 cases X-ray therapy was combined with radium, low voltage being used in the earlier cases, high voltage in the later cases.

Thus far we cannot subscribe to the feeling expressed by Russell, that radium has failed in the treatment of carcinoma of the rectum, nor with Coffey, that the suffering is unspeakable and the results disappointing. It should be borne in mind that the discomfort from the disease itself is intense and that in the cases in which extreme suffering has appeared to be associated with the radium treatment it was undoubtedly due in considerable measure to the extent of the disease itself. We believe that on the basis of the results thus far available we are justified in holding our final judgment in abeyance until sufficient time has elapsed and sufficient statistics have accumulated to form a fair criterion for a final opinion. In any case, the patient who is unwilling to submit to operation is entitled to the chance for amelioration of the disease and prolongation of life, to say nothing of the possibility of an occasional cure, which is offered by radiation therapy.

TABLE I

CARCINOMA OF THE RECTUM

(Cleveland Clinic Series, 1921-1925)

Method of Treatment	Average Survival Period: Living	Dead
Colostomy	12 mo.	5 mo.
Colostomy and Resection	19 mo.	6 mo.
Colostomy, Resection and Radiation	28 mo.	11 mo.
Radiation Only	17.5 mo.	13 mo.
Radiation and Colostomy	15 mo.	14 mo.

TABLE II

CARCINOMA OF THE RECTUM AND SIGMOID

(Cleveland Clinic Series, 1921-1925)

Total Cases	136
Not Treated	22
Treated	114
Colostomy Only	29
Colostomy and Resection	14
Colostomy, Radium and X-ray	48
Colostomy, Resection, Radium and X-ray	8
Radium and X-ray without Colostomy	12
Laparotomy, Exploratory	2
First Stage Coffey Operation	1

TABLE III

CARCINOMA OF THE RECTUM

Treated by Radiation

(Cleveland Clinic Series, 1921-1925)

Survival Period	Number of Cases	Still Living
3 yrs. or more	20	30 %
2–3 yrs.	10	60 %
1–2 yrs.	16	62.5%

DISCUSSION

DR. I. S. TROSTLER (Chicago): I would like to have Dr. Jones promise to report to

us in five years the results of this same system.

Dr. B. F. Schreiner (Buffalo): I have had the opportunity of treating 184 cases of cancer of the rectum since 1914 by radium and X-rays. Of those 184 cases, there were 15 that fell within the so-called operable class. Twenty-six of the inoperable cases had metastases in the liver when they came for treatment, so one might discount that 26 immediately. In the whole number of cases, there are eleven in which the disease in the rectum and ring has completely disappeared. The period of time runs from six months to four years. Our best case of four years was a mass which laid over the prostate and adhered, and he was needled with emanation, — nothing more was done. He is perfectly well today, so far as one can tell. Thirty-two of these cases were subjected to colostomy at the time of radiation. There is one other patient in this series of whom I want to speak, who is now clinically well, a year and a half after treatment, who had a large mass in the rectum about opposite the level of the cervix, from which we had a biopsy. It was a carcinoma with mucoid degeneration. The woman had lost 60 pounds in weight. The case looked so hopeless that all that was done was to give the woman divided doses of high voltage X-ray. She has gained back 75 pounds, her bowels move regularly without cathartics, and so far as one can see she is clinically well to-day. I have recently reported these cases and they will appear in the *Archives of Cancer Research* in the near future. I am obligating myself to report at the end of five years all cases I have spoken or written of.

Dr. E. T. Leddy (Philadelphia): I was surprised to hear Dr. Jones' statistics, with such good results, and would like to congratulate him on them. They are far better than ours. It may be that the cases we get are farther advanced than Dr. Jones', or it may be that we are not putting radiation enough in them, or that our whole technic is wrong. Our cures are 5 per cent for three years. We seldom use embedded radium in advanced carcinoma of the rectum, for the reason that we do not think the torture the patient undergoes is justified by the additionally good prognosis he gets from it.

It seems to me that one of the most important things in outlining a schedule of treatment for carcinoma of the rectum is simple exploratory laparotomy, for by it only can we get a distinct idea of the anatomy of the disease. Furthermore, it definitely decides operability, as we have found that in many of our cases metastases to the liver had taken place from a seemingly operable carcinoma. In cases approaching inoperability, although operable at the time, colostomy is definitely indicated for two reasons: first, the progress of the disease is going to necessitate it, and if colostomy is done, one can completely discount the possibility of obstruction, due to radiation.

In most cases of advanced carcinoma of the rectum, our radiation has included very little radium. We have abandoned intensive X-ray treatment of this disease. Whether our poor results are due to wrong intensity of treatment or poor technic, I cannot say at present, but our results are nearer 5 per cent of three-year cures than any other figure.

Dr. Jones (closing): In a case of cancer of the rectum, I think the first thing to do is to make a colostomy. As far as I am concerned, I would rather not radiate a carcinoma of the rectum unless the patient submits to a colostomy. It has been my experience that after a couple of months the patient can keep himself a great deal cleaner than is possible with a lesion in the rectum, especially if it is down around the sphincter, over which he has no control. I think that colostomy is the most important maneuver in the treatment of carcinoma of the rectum. Another maneuver which is sometimes of aid when the growth

is low down in the rectum, is to make a subcutaneous myotomy on both the external and the internal sphincters, by making an incision on the buttock near the rectum and sliding the scissors up under the mucosa. That will do away with the spasm which occurs in many cases after this amount of radiation.

OBSTRUCTION OF THE ESOPHAGUS [1]

By JOHN D. OSMOND, M.D., CLEVELAND, OHIO

THIS report is based on the study of sixty patients suffering from obstruction of the esophagus. The three principal causes were cicatricial stenosis, spastic stenosis and malignancy, the obstruction varying from partial to complete. Three cases of compression stenosis are included which are typical of partial obstruction of extrinsic origin; namely, one due to goiter, one to aneurysm (Fig. 1) and one to enlarged mediastinal glands. Only one foreign body case is included and this is classified with the cicatricial stenosis group because of the large amount of scar tissue that followed the trauma of the early attempts to remove it.

Fig. 1. Compression stenosis due to aneurysm of descending aorta.

Twelve of the series were cicatricial, ten spastic and thirty-five malignant in origin. The origin of the scar tissue in the cicatricial group corresponds fairly well with the large variety of causes in this class of stenosis. Four were due to drinking some corrosive (Fig. 2), one phenol, one followed a typhoid ulcer. One constriction was considered at first to be malignant but later found to be due to extensive induration of gastric ulcer located high on the fundus. The patient has lived more than a year and has greatly improved since his gastrostomy (Fig. 3).

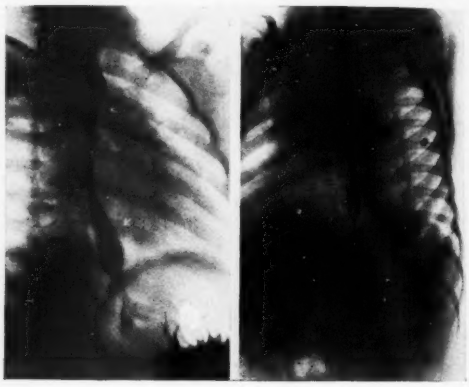


Fig. 2. Cicatricial stenosis, due to swallowing a corrosive.

Lues was not recognized as the cause of any constriction. It is a rare condition. However, one must always give the patient the benefit of a Wassermann and the usual anti-syphilitic treatment if there is no history of trauma and the constriction is smooth in outline.

Obstruction from a foreign body is usually temporary. However, sufficient traumatism may occur from an irregularly shaped object, or from attempts to remove it, to cause scar tissue formation and a firm stenosis. The patient included in this series is a little girl, nine years of age, who swallowed a jackstone (Fig. 5*A*). Attempts to remove it being unsuccessful, after about three weeks she was taken to

[1] Read before the Radiological Society of North America, at Atlantic City, May, 1925.

A B C

Fig. 3. Extensive induration of gastric ulcer. (*A*) Film made September 30, 1924. Operation on October 6, 1924, at which time the induration was considered to be possibly malignant. However, a gastrostomy tube was inserted. (*B*) Film made November 29, 1924, showing some improvement. (*C*) Film made March 19, 1925, showing marked improvement. On March 31, 1925, at second operation, all induration had disappeared and gastrostomy opening was closed.

Dr. Jackson in Philadelphia. Two weeks later, after carefully dilating several constrictions, the foreign body was finally uncovered and removed. A gastrostomy, followed by guided bouginage, has given a good lumen (Fig. 5*B*).

Spastic stenosis as encountered in this series is limited to the lower portion of the esophagus. All ten cases can best be referred to as cardiospasm. All of them lived long enough—two to ten years—to rule out an associated malignancy. All have responded to the forceful stretching of the musculature, with the exception of one, not treated. One required a gastrostomy and digital stretching of the cardia, as described by Walton (Ref. 5, Fig. 7). No ill effects have been obtained. Two gained sixty pounds, one gained eighty. Rapid eating or the gulping of food are considered predisposing factors in cardiospasm. The youngest patient was sixteen and the oldest seventy-eight. One of the ten had a severe hemorrhage the second day after the X-ray examination, followed after a few days by a gastrostomy. Ten weeks later the writer introduced an esophagoscope and detected a scar about a half inch above the cardiac opening, this evidently being the source of the hemorrhage and the cause of the spasm before the hemorrhage. Therefore, some might wish to classify this case as a secondary spasm. Such erosions or ulcers undoubtedly cause a spasm and may be the seat of a later malignancy.

MALIGNANCY

Fifty-eight per cent of the cases were malignant, a higher percentage than that reported by Vinson and considerably lower than that reported by Willy Meyer. Malignancy occurred six times more frequently in men than in women (see Chart). The lower third of the esophagus was involved in half of the malignant cases, and the middle third more frequently than the upper third, and the youngest patient having carcinoma was twenty-three years old. At first his obstruction was thought to be only a cardiospasm. However, it did not relax easily with the bougie and no improvement followed. Dilation of a malignant stricture is now considered a permissible form of treatment; it prolongs life and gives greater comfort than a gastrostomy.

The diagnosis of carcinoma of the esophagus can usually be made from the ragged, irregular outline of the filling defect in the barium shadow of the lumen. When the growth is at the cardiac opening and

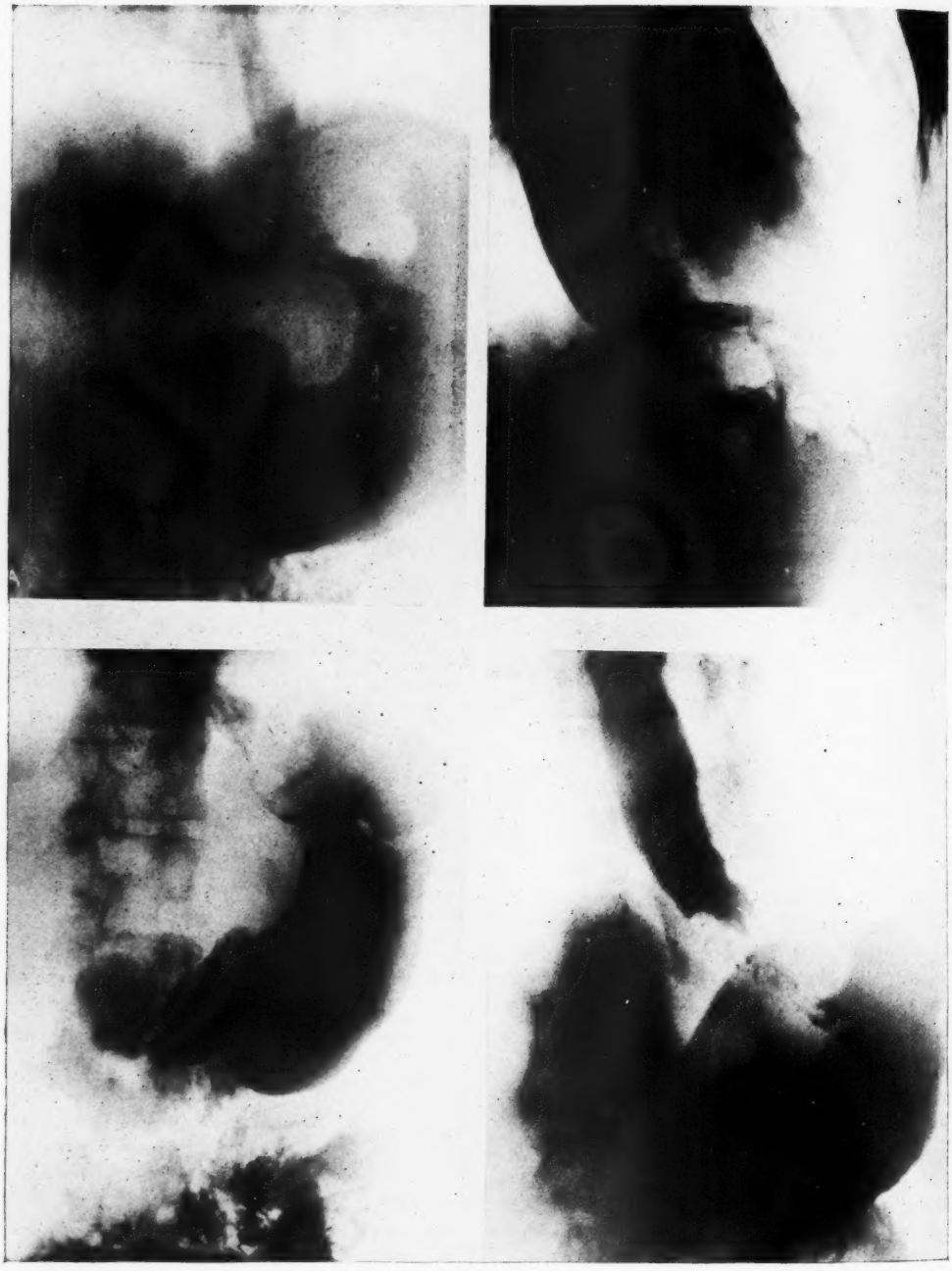


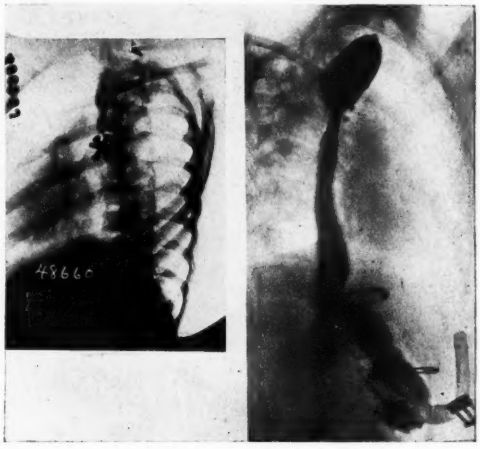
Fig. 4. Carcinoma involving esophagus and lesser curvature of fundus. *(A)* Film made April 15, 1924. *(B)* and *(C)* Films made November 4, 1924. *(D)* Film made February 5, 1925. Compare with benign induration in Figure 3.

involving the fundus, the barium shadow of the esophagus will be compressed on one or two sides. A patient does not live long enough after the beginning of a malignant stenosis to develop any marked degree of dilation above the stricture. The degree of malignancy of cancer of the esophagus is high; Broders has graded it as three or four, which is about the same as cancer of the cervix.

CHART—CARCINOMA OF ESOPHAGUS

No.	*Sex*	*Age*	*Location of Lesion*
1.	Male	54	Upper third
2.	"	66	" "
3.	"	59	" "
4.	"	48	" "
5.	"	57	" "
6.	"	52	Middle third
7.	"	45	" "
8.	"	63	" "
9.	"		" "
10.	"	48	" "
11.	"		" "
12.	"		" "
13.	"	54	" "
14.	"		" "
15.	Female	48	" "
16.	"	43	" "
17.	Male	45	Lower third
18.	"	37	" "
19.	"	53	" "
20.	"	61	" "
21.	"	53	" "
22.	"	51	" "
23.	"	49	" "
24.	"	54	" "
25.	"	50	" "
26.	"	65	" "
27.	"	60	" "
28.	"	70	" "
29.	"	23	" "
30.	"	67	" "
31.	"	47	" "
32.	"		" "
33.	Female	57	" "
34.	"	68	" "
35.	"	61	" "

An X-ray examination should be made before any instruments are used in the esophagus. Dr. Andrew Campbell, of Edinburgh, in describing a case of stricture of the esophagus with unusual com-



A B

Fig. 5. (*A*) Jackstone in esophagus, July 27, 1921. This illustration was kindly loaned by Dr. W. F. Manges. (*B*) Guided bouginage for nearly three years has given a good lumen (May 9, 1924). Gastrostomy opening was maintained to guide the bougie; it has since been closed (May 13, 1924).

plications, writes that "it is regrettable that X-rays were not used for diagnosis." Dr. Chevalier Jackson insists upon an X-ray report before he will attempt either an esophagoscopy or a bronchoscopy.

Patients referred for examination of the esophagus are required to abstain from all solid and liquid food for at least six hours. If there is history of regurgitation of moderate or large quantities of food, a tube is introduced and the esophagus is emptied of food contents; otherwise an irregular outline of the barium meal might simulate the filling defect of a carcinoma. One of the most typical cardiospasm cases in this series had been diagnosed as carcinoma by a famous internist because the food contents in a dilated esophagus had not been removed. The patient was given six weeks to live and has now lived ten years (Fig. 13).

The first X-ray procedure is a preliminary fluoroscopic examination. If any

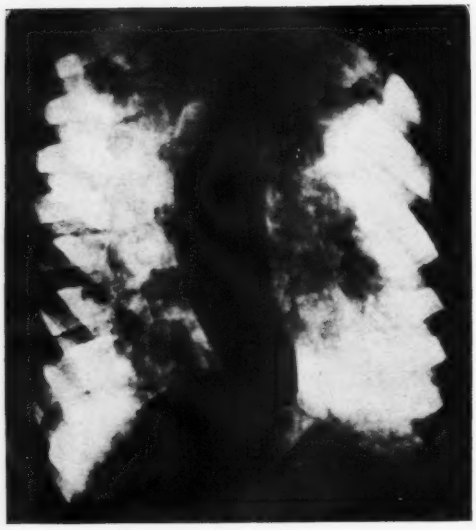
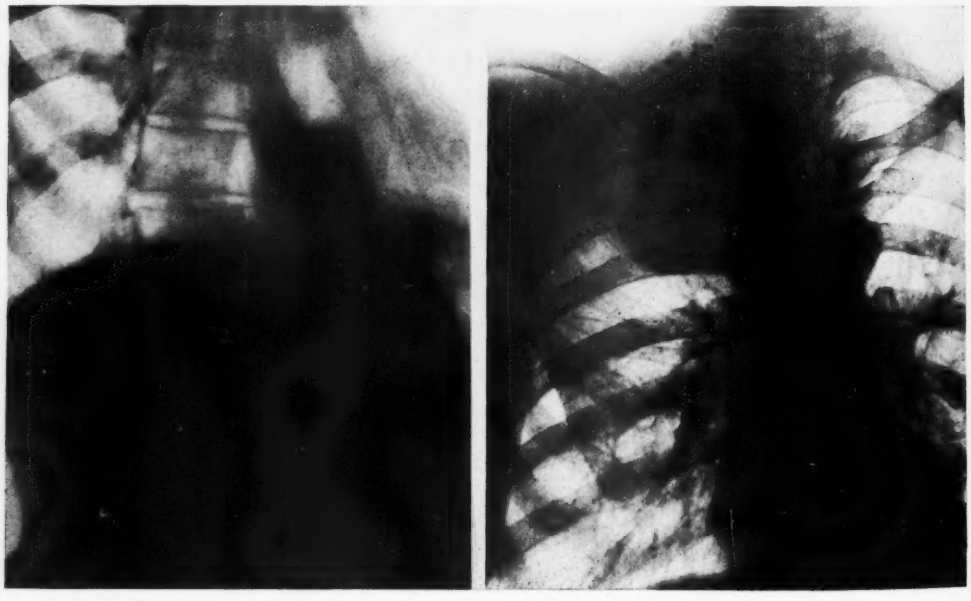


Fig. 6. Cardiospasm. Typical shadow is inverted cone shape with smooth borders.

Fig. 7. Cardiospasm, relieved for six years by bougies. Patient gained 60 pounds in five months. Acute symptoms, lack of nourishment and loss of weight were returning when this film was made. A gastrostomy was then done and the cardia dilated to the width of four fingers by the method described by Walton (5).

chest pathology can be detected stereoscopic films are made.

If the patient gives a history of having swallowed a foreign body a medium-sized capsule of bismuth is given. If the capsule lodges, the level of the obstruction is noted



A B

Fig. 8. (*A*) Carcinoma of lower esophagus resembling cardiospasm. (*B*) Same patient, film made same day as (*A*), showing metastatic carcinoma of first rib.

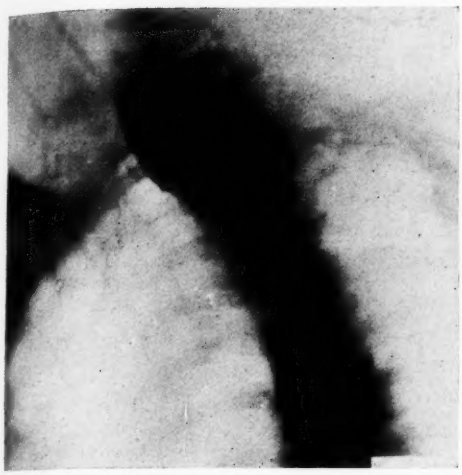


Fig. 9. Carcinoma of upper third of esophagus. Confirmed by autopsy.

and films are made with the patient in the standing position. If there is no history of foreign body and the patient complains only of dysphagia, the procedure is as follows: The patient takes two or three swallows of a liquid barium meal. If there is little or no sign of obstruction he swallows several spoonfuls of a thick opaque mixture. This will mark the upper limits of the obstruction. He is then placed in the prone right oblique position, described by Manges. If a glassful of moderately thick barium meal is then taken quickly through a large rubber tube the entire compression of a tumor will be outlined. One obtains information in regard to the lower limits of an obstruction as well as the upper limits; also the caliber of the lumen and the thickness of the wall can be determined. It is especially desirable to outline a small tumor or to determine the infiltration of the esophageal wall by a malignant growth.

A B C

Fig. 10. Carcinoma of middle third of esophagus. (*A*) Case No. 9 in Chart. (*B*) Case No. 8 in Chart. (*C*) Case No. 15 in Chart.

The change from the upright to the horizontal position has served to differentiate a diverticulum from a possible infiltrating tumor mass (Figs. 14*A* and *B*).

When there is more than one narrowing of the lumen, as may result in cicatricial stenosis due to swallowing some corrosive, the radiogram made in the horizontal position clearly outlines the distance from one constriction to another and the size and shape of the recesses between the constrictions.

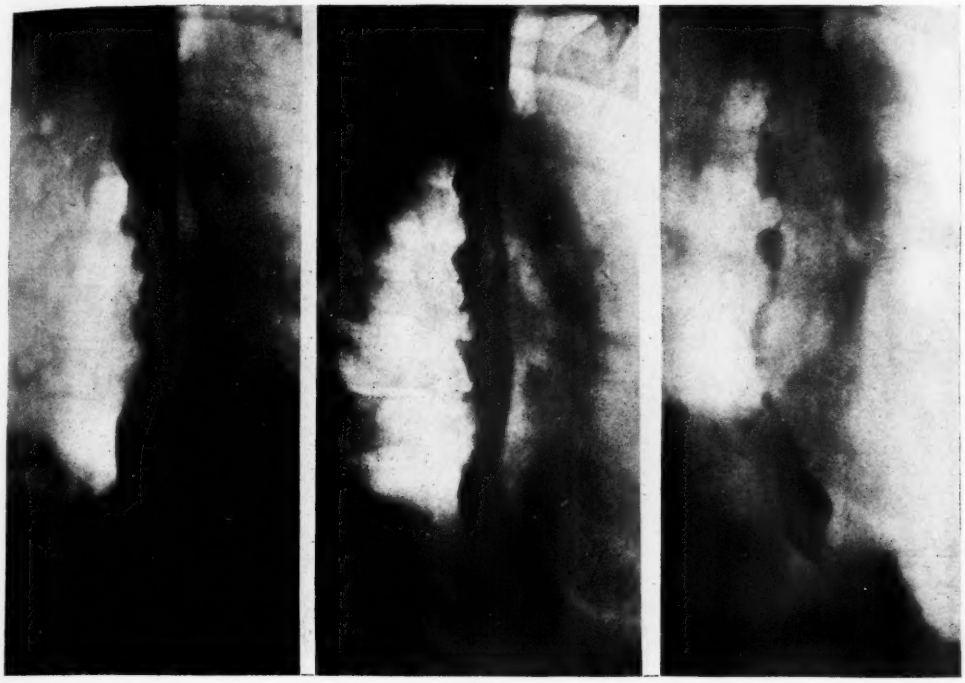
Lesions in the esophagus are frequently found in patients referred only for gastro-intestinal examination. If the patient complains of high epigastric pain, diligent search may lead to the diagnosis. Two cases will illustrate this point.

1. A routine gastro-intestinal examination, including the barium enema, had revealed nothing to account for general epigastric pain. There had been no delay of the barium meal in the esophagus. However, upon giving the thick barium mixture, an irregular filling defect was seen in the lower esophagus. A film made in the right oblique prone position established the diagnosis of carcinoma of the lower esophagus (Fig. 15).

2. A gastro-intestinal examination had revealed no gastric or duodenal ulcer. Considering the high epigastric pain the esophagus was examined by giving the thickened meal through a tube, the patient being in the horizontal position. The films revealed a perforating gastric ulcer on the

A B C

Fig. 11. Carcinoma of lower third of esophagus. (*A*) Case No. 18 in Chart. (*B*) Case No. 19 in Chart. (*C*) Case No. 20 in Chart.



A B C

Fig. 12. Carcinoma of lower esophagus showing a progressive filling defect in Case No. 6 in Chart, from February to August, 1923. (*A*) Film made February 6, 1923. (*B*) Film made April 19, 1923. (*C*) Film made August 22, 1923.

lesser curvature of the fundus, half an inch below the cardiac opening of the esophagus (Fig. 16).

CONCLUSIONS

1. Although about 60 per cent of esophageal obstruction is due to carcinoma, the other 40 per cent can be cured.

2. Benign stenosis will go on to complete obstruction if allowed to remain untreated. Even a cardiospasm will cause death from prolonged lack of water and nourishment.

3. An X-ray examination should be made in every case of dysphagia. If the diagnosis is not made at the first examination, repeated examinations should be made at intervals of two or three weeks. An invisible foreign body must be excluded as a cause of dysphagia.

4. A careful X-ray examination of the esophagus should be made in the case of all patients referred for gastro-intestinal study, if there is a complaint of high epigastric pain.

REFERENCES

CAMPBELL, ANDREW, M.D., F.R.C.S., Edinburgh: Case of Stricture of the Esophagus, with Unusual Complications. Jour. Laryngol. and Otol., October, 1924, p. 566.

VINSON, PORTER P., M.D.: Carcinoma of the Esophagus. Am. Jour. Med. Sci., September, 1923, p. 402.

JACKSON, CHEVALIER, M.D.: Cicatricial Stenosis of the Esophagus. (Peroral Endoscopy and Laryngeal Surgery, 1915.)

TUCKER, GABRIEL, M.D.: Treatment of Cicatricial Stenosis of the Esophagus. Jour. Med. Soc. of N. J., February, 1925, p. 56.

WALTON, A. J., M.D., London: Surgical Treatment of Cardiospasm. Brit. Jour. Surgery, April, 1925, p. 701.

DISCUSSION

DR. W. I. LEFEVRE (Cleveland): At a recent meeting of our local roentgenologi-

Fig. 13. Cardiospasm. The filling defect in the lower esophagus is due to food contents not removed before giving the barium mixture. The patient gained 60 pounds after two dilations and has remained in good health for more than ten years.

Fig. 15. Carcinoma of esophagus not observed during gastro-intestinal examination with a thin barium mixture. Because of epigastric pain the esophagus was examined, using the thick barium mixture, with the patient in the horizontal position. This re-examination established the diagnosis.

A

B

Fig. 14. (*A*) Film made in upright position; diagnosis not certain. (*B*) Better detail of lumen, indicating diverticulum.

cal society, I presented films of an interesting case of obstruction of the esophagus. The patient, a male, aged 58 years, has suffered with difficult swallowing for the past ten years. At present the esophagus is dilated to about three times its normal size, the outline is smooth throughout, the restricting line on a level with the diaphragm. There is complete retention, even of liquids, which the patient can overcome by taking a swallow of cold water and then producing a peculiar elevating and expanding motion of the chest. When he does this the fluid immediately flows into the stomach, as observed with the fluoroscope. This he can repeat at will. The fundus of the stomach is considerably dilated with a large amount of retained gas. The liver and gall bladder are negative to X-ray examination. Apparently a case of cardiospasm of unknown etiology.

Fig. 16. Perforating gastric ulcer discovered during examination of esophagus. The thin barium mixture did not remain long enough in the niche to be seen on films made at the gastro-intestinal examination.

RADIO-ACTIVE SUBSTANCES AND THEIR THERAPEUTIC USES AND APPLICATIONS

RADIOTHERAPY OF CANCER OF THE UTERINE CERVIX

By JOSEPH MUIR, M.D., New York

II. PATHOLOGICAL

BEFORE undertaking to discuss the effects of radiation upon malignant disease of the cervix uteri, it becomes essential to touch briefly upon the etiology and pathology of the condition, the treatment of which we propose to consider.

Etiology. — While this particular form of carcinoma shares with similar manifestations in other parts of the body the uncertainty as to origin which pertains to all malignant growths, the great preponderance of uterine cancers—cervical cancers especially—in women who have borne children, offers a very significant indication of the part played by the injuries so frequently consequent upon parturition, and the long-continued irritations which in so many instances result from the inflammatory conditions which follow childbirth. In statistics gathered by Crile we find that Pollese reported chronic endocervicitis as preceding cancer in thirty-four out of forty-eight cases, and that Ewing regards polypoid myomas of the cervix as prone to be malignant, no matter what the age of the patient at the time they appear. In his opinion, the discovery of a myoma in the cervical region should be considered positive evidence of conditions predisposing to malignancy. This author studied three uteri where polypi arose in the eroded cervices, these growths being followed by metaplastic overgrowth and beginning invasion of the stroma by adenocarcinoma. Graves remarks that cancer of the cervix "is distinguished among other neoplasms of the body by having a very definite and constant factor in its histogenesis, because it occurs almost exclusively in cervices that have been the seat of some inflammatory or traumatic lesion."

Type.—The relative malignancy of the different types of carcinoma which invade the cervix was not long ago studied with great thoroughness by Martzloff of Johns Hopkins. He found that the cells seen in epidermoid cancer of the cervix fall morphologically into three large groups, namely, spinal cells, transitional cells and fat, spindle cells.

Spinal cells are morphologically similar to those seen in the upper portion of the mucosal stratum of ordinary cervical epithelium; they are, in most instances, of polyhedral form, with well-defined outlines, nuclei of fair size, not infrequently nucleoli also, and are quite widely separated from one another by an abundance of cytoplasm. This cytoplasm takes a rather pale eosin stain, while the nuclei stain quite intensely with hematoxylin.

The transitional type, which is by far the most common, is so designated on account of the resemblance of its cells to a well-defined layer of normal cells of the cervical epithelium, limited above by the spinal cell layer, and below by the distinct Malpighian layer or stratum germinativum. This cell-group is surrounded by a membrane so faint as to be almost indefinable. Their nuclei stain a deep blue with hematoxylin, frequently have nucleoli, and are rather closely placed, being separated by a deep eosin-staining cytoplasm, much less in quantity and capable of taking a deeper stain than is that separating the nuclei of the spinal cell group.

The fat, spindle-cell type is, as its name indicates, a broad spindle-shaped cell, appearing in the "basal cell cancer" of many other observers. The author purposely avoids this term, "because it immediately suggests an origin from the stratum germinativum and an idea of benignity which

these tumors do not possess when situated in the cervix uteri." These cells are comparatively broad in proportion to their length, have nuclei staining readily with hematoxylin, sometimes containing nucleoli, and are closely packed together with only a small amount of surrounding cytoplasm. Martzloff regards the histomorphology of the predominant types of cells in epidermal cancer to be of importance because from this data we are able to estimate the relative malignancy of a given tumor. His observations have led him to the conclusion that the presence of the fat, spindle-cell type denotes the highest type of malignancy; next to these is the transitional cell growth, and last and least malignant, is the spinal cell type.

Adenocarcinomata, in so far as their relative malignancy is concerned, may be grouped between the transitional and spinal cell types. If epithelial "pearls" are associated with growths of the spinal cell type, they apparently indicate a lessened degree of malignancy in that particular neoplasm.

Early Pathologic Changes.—In order to detect the initial manifestations of cervical cancer, it is absolutely essential that the examiner be familiar with the normal appearance of the region under scrutiny. The importance of this histological knowledge is well brought out by Frankl of Vienna in a series of lectures which he gave before the Royal Academy of Medicine in Ireland several years ago. Although the appearance of the uterine mucosa changes during the different phases of the menstrual cycle, in women who have not yet passed the climacteric, there is always a well-defined clinical picture. The glands uniformly show a single layer of epithelium, and there is never any coalescence of the tubules, every one of these structures appearing sharply isolated. The cubical or cylindrical form of the epithelial cells is consistently maintained, though during the secreting stage, the cells are less clearly outlined, as is always the case with any secreting cell.

Place of Origin.—Though a carcinoma can develop in either the mucous membrane or the stratified epithelium, the formerly prevailing opinion that such a growth might take its rise from a single, fully developed element of one of these structures is no longer current. It is now generally accepted that the starting point of cancer is in incompletely developed embryonic cells which have failed to share in the fabrication of the mucous membrane during fetal life, or areas of stratified epithelium similarly "left over"—the so-called epithelial rests. The newgrowths which arise in this way, very closely simulate histologically the structure of the mucosa or epithelium whence they originate. We are thus able to distinguish two types of growths—the glandular and the solid. "In the glandular type we find within the carcinomatous projection a cavity which reminds us more or less of a gland cavity. In solid cancers we miss such a lumen. The early stages of solid cancer could be very well observed in a specimen—no larger than the head of a pin—taken from the epithelial fold, not far from the external os. At one side can be seen typical stratified epithelium with normal papilli, the three strata of the epithelium being still recognizable. As we progress towards the other side, the strata gradually disappear, the papilli become thickened, and at the opposite edge fully developed carcinomatous tissue can be discerned. In the flat epithelium of the vaginal portion of the cervix, the early stages of cancer may display one area of perfectly normal structure. Thereafter, it shows a sudden upheaval. The arrangement in three parts disappears; at the surface appear large polymorphic and deeply stained nuclei, and there is an absence of the regular basal-cell layer."

It is to Cullen that we are indebted for a description of what is apparently the earliest—in point of development—observation ever made upon cervical cancer. The findings were made accidentally during the routine examination of scrapings from a curettage applied for the relief of metrorrhagia, which "yielded a most beautiful example of early proliferation of the epi-

thelium, associated with the development of a squamous-cell carcinoma." Examination of this specimen showed that while the squamous epithelium at some points was perfectly normal, it gradually increased in amount until it was three or four times as thick as normal. "At other points the epithelial cells bore a rather confused relationship to one another; in other words, they presented a rather jumbled-up appearance instead of preserving their usual orderly arrangement." At one point a typical epithelial pearl was found. The cylindrical epithelium of the cervix maintained its normal aspect, but at several points upon the surface aggregations of cells which resembled masses of squamous epithelium were noted. The exact origin of these cell-groups is rather obscure, "but we know that in some cases the squamous epithelium extends up the cervical canal as far as the internal os. In such cases the cervical glands open directly into a cavity lined with squamous epithelium." The manner in which the "finger-like processes" of squamous-cell carcinoma develop is most wonderfully illustrated in this early specimen. In the very earliest stage a papilla has attained fully twice its normal length, a line of demarcation between its surrounding epithelial cells and those of the adjoining epithelium, showing clearly that it is in the active growing stage; the finger-like process is already fairly well differentiated. At most points these processes are already clearly defined and broad, with a well organized stroma and a covering of squamous epithelium several layers in thickness, which stains deeply and shows marked differences from normal epithelium. Scattered throughout the stroma are nests of altered epithelial cells, and under the low-power lens, large deeply staining epithelial nuclei can be made out; under high power, the variations in the sizes of the epithelial nuclei are clearly evident.

These observations upon the early manifestations of malignancy in the cervix uteri are of paramount interest to the radiotherapist, for it is now recognized—though by no means as widely nor as fully as it should be—how much the success or failure of this therapy depends on a thorough knowledge of every phase of the pathologic process he has undertaken to combat.

The established tumor is described by Ewing as composed of columns of transitional epithelium, the good-sized cells of which are either rounded or polyhedral. There will be no evidence of "epithelial pearls" nor of keratosis, but giant-cells are commonly in evidence. In some areas the epithelial columns will be found adherent to one another because of an entire absence of stroma between them; but where stroma can be made out it will be found to be vascular and infiltrated by mononuclear or eosinophile leukocytes. The tumor mass is apparently built up by incurving and eversion of the entire epithelial layer, which has been crowded upward into folds as it increased in thickness, so that a bulky papillary mass has gradually formed. Though from time to time side-shoots are given off from the main growth, there is no early division into small cell-collections, as is so often observed in acanthoma, and this accounts for a characteristic of cervical carcinoma of the utmost importance to the radiotherapist, that is, the tendency toward late metastasis. To this characteristic mode of growth, we are told by Ewing, is due "the presence of free-lying foci of pus surrounded by tumor cells and the abundant growth of blood vessels in elongated papillæ." Ruge has designated these growths as carcinoma *evertus* and carcinoma *invertus*, the first growing outward in papillary form, while the second takes its course inward, gradually invading and infiltrating the tissues which it encounters. Thus are produced the so-called "cauliflower" growths of the cervix, which often occupy both lips and involve the vagina, "forming"—to quote the words of Frank—"huge friable red to pink, grape-like masses which bleed upon the slightest touch." The cervical tissue is also involved, appearing translucent, gray-

ish-white on section. Comedo-like cell nests or "cancer juice," if the nests are smaller, can be expressed from the surfaces of the cut if one is dealing with the medullary type of growth—the scirrhous form is harder and "less juicy."

Distribution.—According to Ewing, the histogenesis of neoplastic growths of this type has been traced to the stratified epithelial lining of the cervical canal, and the ducts of the glands. "The distribution of this type of epithelium is subject to considerable variation, and it is probable that before and during the development of carcinoma the cylindrical epithelium is transformed into stratified cells or replaced by those cells from a lower level. This metaplasia may extend even to the endometrium and its phases may often be traced in chronic erosions."

The majority of the victims of cervical malignancy do not come into the hands of the radiotherapist until the process is far advanced. The picture with which he is most often confronted has been graphically sketched by Frank: "More commonly the patient is first seen when disintegration of the cervix, due to breaking down of the growth, has begun. Part or all of the infravaginal portion of the cervix may have disappeared. A hard, irregular, nodular cavity, formed above by the infiltrated vaginal vault, soon develops. The growth bleeds readily to the touch. The broad ligaments may show induration. The limits of extension along the vagina are elevated, nodular and hard. The upper limits of the intracervical parts of the tumor cannot be determined until the specimen is cut open. . . . The gross appearance is most varied, depending upon the relative amount of induration and excavation, the presence or absence of cauliflower projections and upon the direction of extension. In some cases the portio may appear almost intact, on section showing complete involvement of the circumference of the cervical canal. Again, a large cauliflower mass may have only a small pedicle attached to the cervix. In the harder, more fibrous forms, retraction of the tissues may hide the loss of substance, by puckering and shrinking of the vagina, as in senile vaginitis. The far-advanced cases present a foul-smelling, indurated crater whose walls are formed by cancerous tissue which may extend laterally to the pelvic wall. Eventually, indescribable cloacæ which drain uterus, bladder or ureters and rectum may develop, especially if radium treatment is employed after the vesico-vaginal and recto-vaginal septa are already infiltrated by cancer."

Williams observed that the tendency of epithelial cancers "is to spread superficially rather than deeply; and the disease progresses toward the vagina rather than toward the uterus." It is only during the later stages that it invades the pelvic connective tissue, finally infiltrating the tissues of the bladder, rectum and other neighboring structures. "Eventually dissemination in the adjacent pelvic lymph glands may occur, but metastases are decidedly rare."

Lymphatic Involvement. — This opinion is very generally shared by many authorities. Perhaps the greatest difference between the manifestations of malignancy when located in the mammary region and in the uterus, is the rapidity and wide distribution of the lymphatic involvement in breast cancer, compared to the usually slow and late extension to the lymphatic glands affiliated with the uterus.

According to the investigations of Poirier, the origin of the cervical lymphatics is in the mucous membrane and muscular coats. They pass thence to the periphery of the cervix, where they take on convolutions, and in this shape pursue a transverse direction, the different branches forming anastomoses one with another, or several may unite to form a single large trunk. These larger lymphatic ducts, usually three or four in number, follow along the courses of the uterine arteries and, arriving at the lateral wall of the pelvis, pass over the hypogastric vessels and the obturator artery and nerve, until they attain the upper group of hypogastric glands, which lie at

the bifurcation of the common iliac artery. This upper group usually consists of two or three glands. The highest lying—which is also the largest—is found at the peak of the angle made by the external iliac with the hypogastric artery, and lies in front of the external iliac vein. The other gland or glands are within the pelvis, as they are situated lower down, along the course of the hypogastric vein. In addition to these constantly found lymphatics, both Sappey and Peiser mention that they have frequently encountered several lymph vessels which also take their origin in the cervix, but, passing out into the sacro-uterine ligaments, go up in front of the sacrum, and empty into the sacral glands. This group, according to Waldeyer, contains five or six small glands, and lies partly in the course of the median sacral artery and also in those anterior sacral foramina which surround the lateral sacral vessels. The two sacral glands, already spoken of, anastomose with each other, their lymphatic ducts branching off so as to empty themselves into some of the common iliac glands. Gellhorn emphasizes that it is well to bear in mind that the so-called iliac or hypogastric glands are subdivided into three distinct groups, namely, the hypogastric, external iliac and common iliac, and these distinctions must be kept clear despite the fact that they all have intimate interconnection with one another.

Explanation of Late Lymphatic Involvement in Uterine Cancer.—In view of the anatomic arrangement which has just been outlined, it is, as Cullen has said, "rather astonishing" that glandular involvement, when the uterus is the seat of malignant disease, ordinarily occurs so late. He explains this on the ground of the large size of the epithelial cells found in all types of uterine cancer, which may possibly prevent their entrance into the lymph radicles. "Accordingly, the lymphatics will not be involved until the growth has extended far laterally, and eaten into a large lymph channel. This is the view held by Lubarsch, and would seem to be satisfactory." Ewing, however, does not agree with this general view, and cites the work of Baisch, who found that the regional nodes were involved in 33 per cent of the operable cases of cervical carcinoma; even when the parametrium is macroscopically free the nodes are affected in from 5 to 16 per cent, while with infiltrated parametrium the nodes are affected in fully 50 per cent of the cases. "Rarely the regional lymph nodes are said to escape, while more distant ones are involved." He concludes that "it has been repeatedly shown that only microscopical examination is a safe guide to the condition of both swollen and small lymph nodes."

Mode of Extension.—When extension to the lymphatics does take place, it occurs by penetration of the proliferated epithelial cells from the original malignant focus upon the cervix into the spaces within the connective tissue "until they reach larger lymph spaces lined with endothelium, which are found around the capillaries and glands of the uterus. The energy of extension depends upon various factors, such as age of the patient and pregnancy." It has been demonstrated by Seelig that there are small lymph vessels which receive the fluid from these spaces and convey it to other perivascular lymph vessels between the median and outer muscular layers of the uterus. "These lymph vessels, in all parts of the organ, freely anastomose with one another. After passing through this complicated network of lymph channels, the carcinomatous cells emanate from the borders of the uterus into a limited number of larger lymph vessels," mention of which has already been made.

Comprehension of Process of Lymphatic Extension Important to the Radiotherapist.—The importance of the relations, both normal and pathologic, between the cervix and the lymphatic system of the uterus, should need no emphasis, and it is obvious that any attempt to apply radiotherapy without a full comprehension of these relations, as well as of the clinical nature and progress of the disease, would be equally

fruitless and disastrous to physician and patient alike. Many of the failures which have served to cast suspicion upon the value of radio-active agents can be wholly attributed to just such ignorance on the part of those who applied them, and no real progress can be expected except by those who are willing to master the details of anatomy and pathology, with which every form of treatment of cervical malignancy is inevitably conjoined.

REFERENCES

1. Crile, George W.: Carcinoma of the uterus. Am. Jour. Obst. and Gynec., 7:528, 1924.
2. Cullen, T. S.: Early squamous-cell carcinoma of the cervix. Surg., Gynec. and Obst., 33:137, 1921.
3. Ewing, James: Neoplastic Diseases. Second ed. W. B. Saunders Co., 1922.
4. Frank, R. T.: Gynecological and Obstetrical Pathology. D. Appleton & Co., N. Y., 1922.
5. Frankl, Oskar: Early diagnosis of carcinoma of the uterus. Dublin Jour. Med. Sc., 4th series, No. 21, November, 1921, p. 491.
6. Graves, W. P.: Gynecology. Third ed. W. B. Saunders Co., Philadelphia, 1923.
7. Martzloff, K. H.: Carcinoma of the cervix uteri. Johns Hopkins Hosp. Bull., 34:141 and 184, 1923.
8. Poirier, Paul: Lymphatiques des Organes Génitaux de la Femme. E. Lecrosnier & Babeé, Paris, 1890.
9. Ruge, Carl (Sr.): Epithelialveränderungen und beginnender Krebs am wieblichen Genitalapparat. Arch. f. Gynæk., 109:102, 1918.
10. Gellhorn, George: The lymph glands in uterine cancer. American Gynecology, 1:476, November, 1902.

A RADIOLOGICAL RETROSPECT

By ALBERT SOILAND, M.D., F.A.C.R., Los Angeles

THAT radiology as a science is the inherent property of the trained medical radiologist is unquestionable and this fact should be recognized. Up to the present time, the medical profession has been rather apathetic in recognizing this young medical Hercules, if he may be so termed, and he has been left to develop unguided, with acromegalic tendencies. He has been the plaything of every profession, good and bad, but now that he has been finally adopted by the American Medical Association, it is to be hoped that future development will entitle him to respectful consideration among the recognized branches of scientific medicine and surgery.

It should be clearly understood that the term "radiology" in this discussion connotes only that known field of energy of radiation which begins in the lower scale of visible light and ends in the short waves of gamma radiation. Also, this entity should be clearly distinguished from an ever increasing number of technical agents which are listed under the names: electrotherapy, thermotherapy, mechanotherapy, kinesiotherapy, hydrotherapy, vibrotherapy, and the increasing number of therapies grouped under the general term "physiotherapy."

That medical men are awakening to the realization that radiology is entitled to a professional status may well be illustrated by a brief retrospect of the progress in the treatment of disease by radiation during the past decade. At the meeting of the American Medical Association in Atlantic City in 1919, a New York surgeon, speaking before the surgical section, stated that he had never seen a carcinoma of the cervix uteri cured by radium and doubted that he ever would see such an occurrence. Six years later, the *Journal of the American Medical Association* quotes one of America's foremost surgeons to the effect that radium is a specific in early carcinoma of the cervix—truly a revolutionary change of opinion.

Another instance is vividly recalled to the writer's mind where a well known surgical authority, speaking before a medical group of perhaps one thousand, stated that X-rays and radium were of no appreciable service in the treatment of toxic goiter. This same surgeon at present employs both X-rays and radium, not only in the treatment of goiter, but in many other conditions in which the use of these agents was formerly ridiculed.

Now that we are fully launched upon a new therapeutic era, we must not omit to refer to the need for painstaking investigation and care in all work undertaken. It has been repeatedly demonstrated that, in accordance with the amount of radiation employed, the activity of a particular gland or organ may be stimulated or, conversely, either checked or destroyed. This places a responsibility upon us all which cannot be evaded and which we must willingly accept, if we are to extend our services further for the physical wellbeing of our patients. Isolated cases of acromegaly and cretinism, where experimental X-ray treatment to the pituitary gland has been shown to be of benefit, suggest lines of future extension. We had one example in our clinic of a case of hyperthyroidism in a female adult with brain development equal to her age of twenty, but with the physical aspect and size of a child of twelve to fourteen years. She was weak, anemic and spent half of the time in bed. This patient received carefully measured X-ray dosage to the thymus and pituitary glands over a period of three months. Increased physical development began immediately after the installation of treatment and she gained strength and weight rapidly. When last seen, eighteen months after the treatment period, she had grown three inches in height, had matured perceptibly, was able

to drive an automobile and appeared happy and well.

These examples are quoted as a source of inspiration to the radiologist who has plodded along for many years in an earnest endeavor to create for his specialty the professional recognition and respect which are its just due. It is quite true that a number of individuals of high repute in the recognized profession have looked upon the efforts of radiologists with a degree of tolerance which was not altogether one of brotherly love and co-operation, and only after having been awakened to the realization that these men were medical colleagues, earnestly and carefully applying the limited knowledge in their possession to the proper advancement of radiation as a medical procedure, have their efforts been given credence. Not infrequently this education has come to the American clinician who, while touring abroad, has been impressed with the X-ray and radium work he has seen at this or that university clinic, and when, upon his return to America, he has been astonished to find his home radiologist, with whom he may have had only a passing acquaintance, not only qualified to do the same work as that of his European colleagues, but usually as well equipped and as fully alive to the situation.

When it was first announced that radiation was useful in the destruction of hypertrophic tonsils, the men who are engaged in the specialty of rhinology and laryngology were naturally skeptical, and only the most formidable array of clinical evidence has tempered their condemnation of this procedure. There is now a movement in the line of co-operation between laryngologists and radiologists where cases not strictly surgical are permitted radiation therapy.

In dermatology more than in any other medical specialty, radiation therapy finds its greatest field of usefulness. If one visits the clinics of recognized dermatologists to-day, he will find a great number of patients treated by means of X-ray and radium, yet it is a singular coincidence that the textbooks on skin diseases written by these very men only casually refer to radiation, giving the greater part of their text to an impressive array of medicinal prescriptions and formulæ. However, the fact is that their major clinical work is done by means of radiation.

The group of adenopathies offer striking proof of the virtue of radiation therapy. There is no other remedial agent known which will so markedly control the pathology of the lymphatic system as the energy from X-rays and radium. This holds good not only in benign conditions, but is true in the various infections and neoplasms where surgery is insufficient. In this class may be mentioned infections of tuberculosis, syphilis, sarcoma and carcinoma. Indeed, it is not uncommon to meet with a large lymphosarcoma such as those of the mediastinum, the pressure symptoms from which may make the patient appear to be beyond medical help, which responds in a remarkably short time to radiation. A most laudable example of this specific reaction may be noted in the young children suffering from hyperplastic thymus. Many of you have seen an infant struggling for breath and almost purple from cyanosis gain complete relief from a single exposure to the X-ray.

The treatment of leukemia, Hodgkin's disease and lymphosarcoma may with propriety be considered as a group. The outlook in a localized lymphosarcoma is more favorable than that of Hodgkin's disease, and in the very young the prognosis is more hopeful. It is often clinically impossible to differentiate between these two pathogenic tumors, but symptomatic relief for at least a time can be assured. In leukemia patients, life may be prolonged and the patient made comfortable for an indefinite period of time,—as long as ten years in authenticated cases. We know of no other form of therapy that can show results as good as these.

No attempt will be made here to go into the biologic action or manner by which radiation accomplishes its results. That is

a field for the physiologist, the biologist and the pathologist, whose combined investigations and studies are now at our disposal. From them must we glean the knowledge necessary to carry out a practical procedure against this formidable list of human ailments. That we may credit radiation with the reconstruction of tissue can be verified not only by the macroscopic appearance of tissues but by an X-ray examination, which frequently shows actual bone repair and restitution in malignant processes from metastatic cancer of the osseous structures.

There are, as you know, many other clinical conditions wherein radiation, while not curative, is of undoubted value in the amelioration of symptoms and the prolonging of life. In this class come the advanced cancer cases, either inoperable, recurrent or metastatic. In this field the treatment of pelvic malignancy has reached the stage whereby we can venture the statement that by means of this method pelvic cancer as a whole will yield a curative percentage greater than that of any other previous age. It is not unreasonable to suppose that further study and early institution of this form of treatment will substantially increase this percentage. Unfortunately, this statement is not true as yet of cancer of the breast; however, it is within reason to trust that a closer co-operation between surgeon, pathologist and radiologist will surely induce a more hopeful outlook upon this situation.

In summing up the field of X-ray and radium usefulness, it is difficult to indicate any limitation. It can at least be stated that the withdrawal of these agents from medicine and surgery would leave a want to-day that could not be met by any other potentiality within our present knowledge.

In many parts of the United States, repeated attempts have been made by laymen to separate the X-ray from medicine and surgery. To this end bills have been introduced in different States, notably in the State of California, to permit and legalize the establishment of lay X-ray laboratories. When one contemplates the danger to the public of permitting a lay mechanic or an electrician of questionable ability, or any other adventurer, to set up a shop or office for the general medical use of this subtle force, his knowledge of which can be only fragmentary, the need for concerted medical action is apparent. Only by the most strenuous efforts on the part of a handful of the radiological group has it been possible to defeat such a bill, which has on two occasions passed and been approved by the State Legislature of California. The reason for these repeated attempts would seem to be the indifference with which the medical profession regards its duties in relation to public health and legislation. Many of the laity have a firm conviction that the way to quick wealth is by the purchase of an X-ray machine, and they are using every conceivable political subterfuge to pass laws which would permit anyone with sufficient capital to buy the equipment and impose himself upon the public. It need scarcely be reiterated that if we allow X-rays and radium to be taken out of the hands of the medical profession and made public property, the consequences of such a contingency may be beyond repair.

That the medical profession has at last awakened to its responsibility in this field is evidenced by the fact that the American Medical Association has already decreed that radiology is an integral part of the practice of medicine and surgery and cannot be dissociated from it. This is recorded in resolutions adopted in due form by the House of Delegates. That it further signifies its intention of sponsoring the cause of radiology is manifested by its willingness to grant a full Section to this specialty, with all the rights and privileges of a sectional membership. This action will do more to safeguard properly the future development of radiation than any other movement which has been initiated up to the present time.

TREATMENT OF CARCINOMA OF THE BODY OF THE UTERUS [1]

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UNTIL the cause of cancer is known, the cure of the disease must depend on early recognition, and early and complete removal or destruction of the tumor. The recent report of Nuzum's work apparently brings the problem of the etiology of cancer nearer a solution, but the evidence is not yet conclusive that his micrococcus is the cause. The early diagnosis of a malignant condition depends on the recognition of the early symptoms by both the laity and the general practitioner, which is possible only by educating the laity and physician as to the significant early signs and symptoms of carcinoma of the various organs. The appearance of any unusual vaginal discharge, bloody, watery or odorous, or of intermenstrual bleeding before or during the menopause, or of post-menopausal bleeding, is always indicative of carcinoma of the pelvic organs. The fact that the number of deaths from carcinoma is increasing yearly indicates that the medical profession still has much to do in the educational propaganda with regard to early symptoms of this disease. The statistics of the State of New York show a decrease of 337 deaths during the year of 1923 from all other causes, but an increase of 340 deaths (6 per cent of the total number) due to cancer.

The prognosis for cure in cases of carcinoma of the fundus of the uterus is more favorable than for the cervix, as the growth remains confined by the uterine musculature for a considerable time, whereas cervical carcinoma early infiltrates the cervix and invades the parametrium. Boesch found the regional nodes involved in only four of twenty-four cases of carcinoma of the corpus uteri, and Cullen always found the nodes free from involvement.

The lymphatics of the corpus uteri begin in the mucosa and leave the uterus in four or five trunks which pass beneath the tubes, then through the broad ligaments, anastomosing with the ovarian plexus and around the ovarian artery in the ovarian ligament, to end in the lumbar nodes above the bifurcation of the aorta. From the middle of the corpus, other vessels mingle with those from the cervix, reach the iliac nodes, and some pass along the round ligaments to the inguinal nodes. The tendency of carcinoma of the body of the uterus to remain localized and the fact that it occurs in a large percentage of cases later in life than carcinoma of the cervix, enables the surgeon to effect a cure in a larger number of cases by removal of the uterus, although carcinoma of the cervix usually produces symptoms earlier in the course of the disease.

A series of 269 cases of carcinoma of the body of the uterus in which hysterectomy was performed at the Mayo Clinic between January 1, 1907, and January 1, 1921, are reviewed in this report, also a series of forty-one treated by radium between January 1, 1916, and January 1, 1921.

It is of interest to note that 239 (88.84 per cent) of the women operated on were married. Of these, 170 had borne children and thirteen others had had miscarriages. In this group, the largest number of patients (54.27 per cent) were between the ages of fifty-one and sixty, which corresponds to the observation of most writers; 19.33 per cent of the patients were between forty-one and fifty; 18.21 per cent between sixty-one and seventy, and four were less than thirty. One hundred seventy-three (64.31 per cent) had passed the menopause an average of nine and two-tenths years. There were ninety-six women who were still menstruating, 35.68 per cent of the total number, and the average age of these pa-

[1] Read before the Radiological Society of North America, Atlantic City, May 20, 1925.

tients was forty-seven and twenty-eight hundredths years.

A review of the histories of the cases in which hysterectomy was performed shows that of the patients who had passed the menopause the first symptoms noted were: a bloody vaginal discharge in 106 (61.27 per cent), a bloody or foul discharge in thirty-three (19.07 per cent), a purulent and watery discharge in twenty-five (14.45 per cent), a definite hemorrhage in four (2.3 per cent), and pelvic pain in only four. Of those who had not stopped menstruating the first symptoms noted were: intermenstrual bleeding in fifty patients (52.07 per cent), irregular menstruation in eight (8.33 per cent), hemorrhage in four (4.16 per cent), and profuse menstruation in two (2.08 per cent), a bloody, foul or watery discharge in twenty-seven (28.11 per cent), and pelvic pain in five. In view of these observations, any intermenstrual bleeding or a foul or watery vaginal discharge noticed near the age of menopause, bleeding of any character or the appearance of a foul discharge after the menopause should be attributed to carcinoma until proved otherwise.

A cervical polyp will produce the same symptoms but on its removal the discharge ceases. A senile vaginitis, in which there is fine telangiectasis in the vaginal mucosa, may produce a thin bloody discharge suggesting malignancy, but examination with a speculum will reveal the telangiectasis and the fact that the discharge is not from the os uteri. If there is any doubt a curettement for diagnosis should be done. Pyometritis in the elderly woman may cause a discharge very suggestive of malignancy, but in most instances the discharge is purulent and more profuse than with carcinoma and but slightly blood-stained rather than bloody. The uterus may be slightly enlarged and tender. Curettement for diagnosis when pyometritis is suspected is likely to precipitate a pelvic peritonitis; hysterectomy is the safer procedure. Hysterectomy has been done at the Clinic in seven cases in which the diagnosis lay between that of carcinoma and pyometritis. Of these, six were found to be cases of pyometritis and one carcinoma. Intra-uterine polyps, submucous fibromyomas and interstitial fibromyomas may cause intermenstrual bleeding, and a definite diagnosis cannot be made except by a careful curettage and examination of the tissue removed by a competent pathologist. If the history is strongly suggestive of malignancy immediate abdominal hysterectomy is the safer procedure. Deaver notes the very limited value of a curettage for diagnosis, as the small area of carcinoma may be missed by the curette, and suggests abdominal hysterectomy for doubtful cases. In twenty-six cases (19.66 per cent) in which malignancy was suspected, the diagnosis was established by examination of frozen sections of the tissue removed by curettage, and hysterectomy was performed immediately. In twelve other cases the diagnosis of carcinoma had been established by curettage elsewhere and the patient came to the Clinic for removal of the uterus. Unless there are facilities to make the pathologic diagnosis while the patient is under anesthesia, it is better to proceed at once with the hysterectomy, if the history is strongly suggestive of malignancy, than to allow several days to elapse between the curettage and the hysterectomy.

In this series of 269 cases, a definite pre-operative diagnosis of carcinoma was made in 103 cases (38.28 per cent). Carcinoma was the probable diagnosis in eighty-one (30.10 per cent) other cases. A diagnosis of carcinoma of the cervix associated with uterine tumor was made in fifteen (5.57 per cent), and of carcinoma of the ovary in two cases. A diagnosis of uterine tumor was made in fifty-three cases (19.70 per cent), and in these the symptoms of the myoma masked those of the carcinoma. In the remaining cases diagnoses of intra-uterine polyp, endometritis and metrorrhagia were made.

At the time of operation, fibromyomas were found associated with carcinoma in ninety cases (33.45 per cent); adenomy-

oma was associated in three (1.11 per cent); simple ovarian cysts in twelve (4.46 per cent); carcinoma of the ovary in thirteen (4.83 per cent), and the carcinoma had developed on an intra-uterine polyp in twenty (7.43 per cent). There was metastasis to the left tube in one case. A number of case histories were reviewed but not included in this group because it was impossible to determine whether the carcinoma was primary in the ovary or the uterus. As nine of this series of patients had been operated on previously for fibromyomas, the incidence of fibromyomas associated with carcinoma of the fundus is high. Ewing believes that fibromyomas are the first causative factor of the carcinoma, and W. J. Mayo believes that carcinoma of the cervix occurs fifteen times as often as carcinoma of the body of the uterus, but that when fibromyomas are present carcinoma of the body is found five times as often as carcinoma of the cervix, the chronic irritation of the uterine tumors increasing the incidence seventy-five times. Nobel found carcinoma of the fundus more frequently than of the cervix among 5,000 fibromyomas. Williams found carcinoma in 1.4 per cent of his cases of fibromyoma, and Norris and Vogt found that the proportion of cases of fundal carcinoma to fibromyoma was 1+:17. Of their entire series of 115 cases of carcinoma of the body of the uterus, twenty-four were associated with fibromyomas. Norris and Vogt in their report state that of twenty cases in which the diagnosis was clinically benign but proved malignant at operation, fifteen were associated with fibromyoma. These observations should be borne in mind in selecting the cases of uterine fibromyoma for treatment with radium.

Of the 269 patients operated on, 215 had a total abdominal hysterectomy and fifty-four a vaginal hysterectomy, with a hospital mortality of fourteen (5.2 per cent), thirteen deaths following abdominal hysterectomy and one following vaginal hysterectomy. Two patients died from embolism on the tenth and the thirteenth day, respectively, one died from myocardial disease and thrombosis of the renal veins, six from peritonitis, one from uremia and nephritis, one from pneumonia and myocardial disease, one from intestinal obstruction, one from diabetic coma, and one from acute nephritis following chronic nephritis.

Of the total number of patients operated on, 215 have been traced: 108 (50.23 per cent) are living for more than four years, and 107 (49.8 per cent) are dead. One hundred seventy-two (80 per cent) lived three years or more, 155 (72.09 per cent) four years or more, 128 (59.53 per cent) five years or more, 101 (46.97 per cent) six years or more, ninety-nine (46.04 per cent) seven years or more, sixty-nine (32.09 per cent) eight years or more, fifty (23.25 per cent) nine years or more, thirty-eight (17.67 per cent) ten years or more, twenty-eight (13.02 per cent) eleven years or more, twenty-one (9.76 per cent) twelve years or more, twenty (9.30 per cent) thirteen years or more, sixteen (7.44 per cent) fourteen years or more, twelve (5.58 per cent) fifteen years or more, seven (3.25 per cent) sixteen years or more, and three (1.39 per cent) seventeen years or more. Sixteen of the patients who have died some time since the operation are known to have died from some cause other than malignancy. Two patients died from carcinoma of the breast after nine years, one patient died from diabetes after almost eleven years, one from carcinoma of the liver after eight years, one from cerebral hemorrhage after five years, one from "heart failure" after seven years, and one from pernicious anemia after almost eleven years. There were two sudden deaths from unknown causes six months and ten and one-half months, respectively, after operation. One patient died from "paralysis" two and one-half years after operation, one from stricture of the bowel and dilatation of the heart one year after, one from "acute indigestion" three years after, one following operation for gallstones two years after the hysterectomy, one from pul-

monary embolism one and one-half months after, one from uremic poisoning two and one-half years after, and one following thyroidectomy for acute hyperthyroidism one year and three months after the hysterectomy.

Of the 215 patients who had abdominal hysterectomy, 173 have been traced, and eighty-nine (51.49 per cent) are living. Of the fifty-four having total vaginal hysterectomy, forty-two have been traced, and nineteen (45.23 per cent) are living.

Statistics from different clinics with regard to post-operative life vary. The variation is due undoubtedly to what, in the mind of the individual surgeon, constitutes an operable lesion.

Norris and Vogt report that 44 per cent of 115 of their patients are living. Wilson reports only 24 per cent of absolute cures.

Crile reports 34.1 per cent of three-year survivals and 26.8 per cent of five-year survivals, following all types of operation. J. G. Clark reports 42 per cent three-year hysterectomy cures.

In the group presented here, a number of patients were operated on whose condition would probably not have been considered surgical had the operator known beforehand the exact extent of the disease. Thirteen patients were found at operation to have solid carcinoma of one or both ovaries and a papillary cystadenoma of the ovaries, and one patient had metastasis to the left tube.

Norris says that only 17.7 per cent of his patients who had had symptoms for more than a year were saved. The patients in the series reported here were studied to determine the relation of the duration of symptoms before operation to the length of life following operation, and the results were contrary to expectation. Ninety-six patients were operated on before the menopause, and the average duration of their symptoms before operation was 12.33 months. The average duration of symptoms of patients who are still living was 12.26 months, and the average post-operative life eight and one-half years; the average duration of symptoms of the patients who died was 12.42 months, and their average post-operative life two years and five months. One hundred seventy-three patients had passed the menopause before the onset of symptoms, and of those who were traced, 47.79 per cent are still living. The average length of time between the onset of the symptoms and operation was slightly longer than when the operation was performed before the menopause, 16.3 months; for those still living, 14 months, and for those who have died, 18.8 months. The average length of life of those still living was eight and a half years and of those who died the average duration of life following operation was two years.

Mahle showed that cell differentiation was a large factor in the ultimate results of operation; he found that all those patients with a Grade 4 malignancy, the grade showing the least differentiation, were dead, whereas all patients in whom the carcinoma showed the greatest differention (Grade 1), represented by the papillary or polypoid type, are living.

In view of these observations, the duration of symptoms, the age of the patient, the grade of malignancy, and an intangible factor, the personal resistance to cancer or some feature of which we are ignorant, are all determining factors in the prognosis of the individual case. Our youngest patient, a girl of nineteen, presents several interesting and unusual features, her age, and the fact that the history of irregular and profuse menstruation continued for a period of four years during which time she had a curettement with temporary relief from symptoms, then one intra-uterine radium treatment of 150 mg. hours with fifteen months' control of bleeding, then six months of irregular bleeding with a watery discharge and enlargement of the uterus. At the end of this time an abdominal hysterectomy was performed, and extensive adenocarcinoma of the uterus was found. Three years later a left inguinal node appeared which was treated with radium. There has been no evidence of recurrence

since, and the girl is well six years and three months after the operation.

The results of hysterectomy for carcinoma of the fundus of the uterus have always been more satisfactory than for carcinoma of the cervix, and therefore radium has been used for carcinoma of the fundus only when there was a very definite contraindication to operation, or when the condition was inoperable due to extension of the disease, and then only as a palliative measure. There is no means whereby the area of early carcinoma within the fundus may be localized and radium applied to the affected area alone, and when the amount is sufficient to destroy the carcinoma it produces marked irritation of the bladder and rectum.

Reimann, in a study of uteri removed following radium treatment, found marked ulceration of the mucosa at the site of the radium application, and beyond the necrotic area there were living carcinoma cells.

Forty-one patients with carcinoma of the fundus were treated with radium at the Mayo Clinic from January, 1916, to January, 1921. Thirty-eight were married and thirty-two of these had had children. Thirty-two had passed the menopause an average of thirteen and four-tenths years before treatment with radium. The average duration of symptoms in patients who had passed the menopause was eighteen and one-half months, and in those who had not ceased to menstruate, nine months. The diagnosis of carcinoma was established by curettage in twenty cases, but hysterectomy was considered inadvisable owing to various complications such as obesity, hypertension, myocardial disease, nephritis, diabetes, and extension of the disease. Exploration in three other cases showed that the disease was too extensive to admit removal of the uterus. In the three cases explored and found to be inoperable, the patients lived three, ten, and twenty-four months, respectively, after radium treatment. Thirty-two patients had passed the menopause before the onset of symptoms; sixteen of these had had a pathologic diagnosis of carcinoma. Twenty-five have been traced; twenty-three of these are dead and two are living. The latter two had been given a clinical diagnosis of carcinoma, and one is living more than eight years and the other not quite eight years, respectively, since treatment. The average duration of symptoms before treatment in these two cases was one year, and four months, respectively. Of the nine patients who had not passed the menopause before the onset of symptoms, seven have been heard from and four (59.14 per cent) are living. A pathologic diagnosis of carcinoma was recorded in four of the seven, and three are living five, seven, and eight years after treatment. One died one year after treatment. Of the three patients who had been given only a clinical diagnosis of carcinoma, one is living more than five years, and two are dead, one having lived nine months, and the other almost five years. Of the total number of patients treated with radium, thirty-two have been heard from; ten (31.25) lived more than three years, and six (18.71 per cent) are still living more than five years, two of whom are living eight years or more, two, seven years or more, and one, five years or more.

The average amount of radium given to the patients living more than three years was 3,000 mg. hours. In many instances the radium was supplemented by roentgen-ray exposures over the abdomen and back.

Norris and Vogt report the cases of ten patients having carcinoma of the fundus treated with radium and then operated on, of whom 50 per cent are alive after three years; twenty patients were curetted and treated with radium alone and 45 per cent of these have lived three years, and 35 per cent are alive without recurrence.

Three patients reported in the surgical group had had intra-uterine radium treatment before the hysterectomy; one, the girl aged nineteen, was given only a small amount because malignancy was not suspected, but the other two received a moderately large dose without apparent benefit. One patient who was considered an un-

favorable case for operation because of obesity was given 3,400 mg. hours, with cessation of symptoms. Six months later the uterus was removed and the carcinoma had extended to the serosa and there was a large carcinomatous lymph node attached to the sigmoid. A total hysterectomy was performed and the node removed, and the patient is alive and well. The third patient had been given radium elsewhere for profuse bleeding three years previously.

Immediate post-operative radium treatments were given to fifty-four patients and thirty-seven received both radium and roentgen-ray treatments. The subsequent history is known in forty-nine; twenty-two are living and twenty-seven are dead. It is doubtful if in this series the use of radium and roentgen ray following the operation influenced the final outcome; the number of patients receiving treatment is too small from which to draw definite conclusions. It would seem advisable to follow the operation by roentgen-ray and radium treatment in cases in which there is doubt as to whether all carcinomatous tissue has been removed.

Five patients who were treated with radium and roentgen ray for recurrence of carcinoma in the vagina are still alive. One was treated one year and two years after operation, and has lived six years; one was treated four years after operation and has lived seven years since operation; one was treated one year and four years after operation and has lived seven and one-half years; one was treated one year after operation and has lived eight and one-half years, and one was treated eight years after operation, is having roentgen-ray treatments, and is still living nine years after the operation.

CONCLUSIONS

1. Carcinoma of the body of the uterus is most common in the fifth decade and tends to remain localized in the uterine muscularis.

2. A bloody vaginal discharge is most frequently the first symptom of carcinoma after the menopause, and intermenstrual bleeding is most frequently the first symptom before the menopause. Pain is an early symptom in only a few cases.

3. Uterine fibromyoma apparently increases the incidence of carcinoma of the body of the uterus and may mask the symptoms of the carcinoma.

4. Too much reliance must not be placed on a negative report from the microscopic examination of tissue removed by a curette, in the face of suggestive clinical signs of malignancy.

5. Several factors evidently determine the prognosis following hysterectomy for carcinoma: (1) the grade of malignancy; (2) the age of the patient; (3) the duration of the symptoms before operation, and (4) the personal resistance to malignancy, a term used for the unknown factor of carcinoma.

6. The early cases of carcinoma of the body of the uterus are better treated by surgery than radium. X-ray and radium are indicated in those patients presenting definite contra-indications to surgery because of some general condition or extensive malignancy, and in the control of vaginal recurrences of the malignancy.

7. While total abdominal hysterectomy is attended by a higher operative mortality than vaginal hysterectomy, it offers a higher percentage of four-year cures.

BIBLIOGRAPHY

1. Bulkley, L. D.: Cancer death rate in New York City during 1923. Cancer, 1924, I, 196-198.
2. Clark, J. G., and Block, F. B.: Relative values of irradiation and radical hysterectomy for cancer of the cervix. Am. Jour. Obst. and Gynec., 1924, VII, 543-549.
3. Crile, G. W.: Carcinoma of the uterus. Am. Jour. Obst. and Gynec., 1924, VII, 528-535.
4. Deaver, J. B., and Reimann, S. P.: Cancer of the uterus. Am. Jour. Med. Sc., 1921, CLXI, 661-665.
5. Mahle, A. E.: The morphological histology of adenocarcinoma of the body of the uterus in relation to longevity. Surg., Gynec. and Obst., 1923, XXXVI, 385-395.
6. Noble, C. P.: Fibroid tumors of the uterus. Jour. Am. Med. Assn., 1906, XLVII, 1881-1886; 1998-2003; 2065-2071.

7. Norris, C. C., and Vogt, M. E.: Carcinoma of the body of the uterus (with the report of 115 cases). Am. Jour. Obst. and Gynec., 1924, VII, 550-566.
8. Nuzum, J. W.: The experimental production of metastasizing carcinoma in the breast of the dog and primary epithelioma in man by repeated inoculation of a micrococcus isolated from human breast cancer. Surg., Gynec. and Obst., 1925, XL, 343-352.
9. Sappey: Quoted by Ewing, James: Neoplastic Disease. Philadelphia, W. B. Saunders Company, 1919, p. 539.
10. Williams, J. T.: The relation of carcinoma of the corpus uteri to fibroids. Boston Med. and Surg. Jour., 1908, CLIX, 465-469.
11. Wilson, Eden, and Lockyer: New System of Gynecology, London, 1917.

DISCUSSION

Dr. Albert Soiland (Los Angeles): Dr. Stacy's report I consider to be more a surgical than a radiological one. It is excellently gotten up and reflects credit from its source, where the opportunity to observe this type of disease is greater, perhaps, than anywhere else in America. The question of treatment for carcinoma of the fundus of the uterus is an open one; it is just as debatable as the treatment of carcinoma of the breast. If we admit that radiation will cure an early carcinoma of the body of the uterus, why submit that patient to an operation? However, if we can become convinced that surgery takes precedence over radiation, then the question is answered. Certainly the experience of the Mayo Clinic, where they have the best pathological, surgical, and radiological skill available, is hard to refute. At the same time, I do not hesitate to treat by radiation carcinoma of the fundus uteri. If it comes to a question of combined radiation and surgery, I would much prefer the radiation first than afterwards. I do not believe that post-operative radiation in uterine carcinoma is nearly so valuable as a thorough pre-operative course. We have done considerable work on cancer of the uterus in our clinic on the coast, and I feel that the work has not been in vain. I believe that we can clinically show as good results as the average surgeon. That may be a broad statement, but I am not afraid to make it. Whether or not we should rely on radium alone is another question. Some radiologists have believed that they should limit the treatment to radium. We never use radium alone in cancer of the fundus uteri. We are just as careful to give what we consider a deep erythema dose by means of the X-ray as we are with radium, and we prefer to use the X-ray from three portals of entry, over the front, over the back, and through the perineum, and will do that after we have given our 3,000—more or less—milligram hours of intra-uterine radium radiation. Now, having done this, whether we are justified in permitting such a patient to be operated upon, is a question I leave with you.

Dr. B. F. Schreiner (Buffalo): I have collected 56 cases of carcinoma of the fundus, 15 of which were operable, 18 inoperable, and the remainder were recurring cases with metastasis in the pelvis or stump of the vagina. I realize that it is dangerous ground I am stepping on. I believe that probably in a large percentage of cases of carcinoma of the fundus of the uterus it is a surgical disease; nevertheless, there are patients who suffer from diabetes or hypertension or myocardial disease, which contra-indicate operative interference, or else the woman absolutely refuses to have a hysterectomy performed. I have treated 14 cases that were in the operable class. Nine of these women are apparently well, two of them over three years; several of them just beyond two years, so it is rather early to say. In the inoperable cases,—that is, where the tumor has infiltrated the wall or the adnexa or even the bowel—we have had only palliation, varying from three months up to three years. In the recurring cases, 32 per cent are apparently healed. I say this knowing that I am open to criticism, yet there must be cases in which one would be justified in treating by radiation alone. Roughly, the method is this: the patient is given gas; the cervix is dilated; the depth of the uterine cavity is measured; the uterus is curetted, and two, three or four tubes, whichever number is

necessary to fill the whole uterine cavity, are inserted. The dosage runs from 2,000 to 4,000 millicurie hours of radium emanation. This is supplemented with two fields of high voltage X-rays, from the front and back, calculating that the dose, three to five centimeters from the tubes, approximates 130 per cent of the skin dose.

CO-OPERATION AMONG X-RAY WORKERS

By E. C. JERMAN, Chicago

THE importance and value of the X-ray as a diagnostic and therapeutic agent in the fields of medicine, surgery, and dentistry have grown to such an extent during the thirty years of its existence that the full-time services of several thousand individuals are required to carry on the work. Several thousand other individuals devote a portion of their time to this work. These workers may be divided into two major groups, the producers of the equipment and material required and the users of it. The producers may be referred to as the Manufacturing Group and the users as the Radiologic Group.

The Manufacturing Group may be subdivided into several sub-groups ordinarily called departments, as follows: The research department, the production department, the educational department, the advertising department, the credit department, the accounting department, the sales department, and the service department. All these departments ordinarily work under the direction of an executive department, and each department, in turn, may be subdivided into many minor groups.

The Radiologic Group may be subdivided into two sub-groups, the radiologists and the technicians, the latter ordinarily working under the direction of the former. Each of these sub-groups may also be subdivided into a number of minor groups.

The maximum end-result which may be possible can be obtained only by a proper co-ordination of all the activities involved and a proper co-operation between all departments, groups and individuals.

A watch is a complicated mechanism which has been devised and constructed for the purpose of rendering a very great service to humanity in general,—the keeping or recording of time. The parts of a watch may be divided into several groups and these groups subdivided into sub-groups. The parts, for convenience, may be divided into the following major groups: The main spring, the balance wheel, the hair spring, the cog wheels, the supporting framework, the face, the hands, and the case. These major groups may be made up of minor groups; for instance, the cog wheel consists of the body of the wheel, the cogs, the cog interspaces and the shaft or pinion.

THE STORY OF AN ANIMATED WATCH

The various groups and individual parts of a watch may be supposed suddenly to become endowed with the faculty of speech, following which an animated discussion takes place, something like this:

The Main Spring. I am the most important part of the watch. I furnish the power without which all the other parts would be helpless.

The Balance Wheel. I am the most important part of the watch. I stabilize and regulate the power delivered by the main spring; without me the watch would run away with itself.

The Hair Spring. I am the most important part of the watch. The balance wheel could not function without my assistance.

The Cog Wheel. I am the most important part of the watch. I transmit the power furnished by the main spring; without me all your efforts would be in vain.

A Cog. Although I am but a small part of the cog wheel, how could the cog wheel function properly without me?

Following the further claims by the other parts of the watch, the owner closes the discussion thus: "Your arguments are all silly and a waste of time and effort. I am responsible for your very existence. Without me there would be no watch."

The fact is that the user of the watch and every single part of it are important factors in the end-result,—the keeping and record-

ing of correct time. As to whether one factor is of greater or less degree of importance than another factor is irrelevant and of little or no consequence, so far as the end-result is concerned. A defective part in a watch or an incorrect interpretation of the time delivered by a watch through the user, may result in the loss of lives during a battle or the operation of a train. The purpose of the watch is to deliver, through the user, a great service to humanity in general, which has much to do with the proper regulation of life's activities.

The army of X-ray workers are engaged in the rendering of another form of service to humanity. The support for this army of workers must come mainly from the fees obtained by the radiologists from the patients in payment for services rendered. In other words, every dollar received by the radiologist from the patient, for services rendered, must contribute its part towards the support of various individuals of this vast army of workers, each individual of which requires a certain amount of knowledge, skill, and training in order to carry on his part of the work in the most efficient manner. The degree of knowledge, skill, and training may vary somewhat with the individual position, but each contributes its part toward the whole in direct proportion to the efficiency of that individual.

If a member of the research department develops and makes practical a new idea which improves the end-result, he thereby contributes a certain value which should apply to every other individual of the entire group. If a mechanic, at work in the shop, improves the quality of the article he produces or assists in lowering its cost, he thereby contributes his mite towards the success of the whole. If a technician improves the quality of the films he produces, he contributes his part. If the radiologist adds to or improves the quality of the service he renders to the patient, or if he finds a new field in which the X-ray assists in bringing about a better result, he contributes his part, which should react in favor of every other member of the group. If any individual contributes that which proves detrimental to the end-result, he weakens, to that extent, the efforts of every other individual of the entire group. Any individual who devotes his best efforts, in an intelligent, honest and conscientious manner, in this field of endeavor, is an important factor in the end-result, and has the right to the confidence and respect of every other individual.

Only through co-operation of many individuals can great feats be accomplished. The highest commanding officer of an army would be helpless without proper co-operation between the various units that make up the army and even between the various individuals who make up the units. An individual of the lowest rank might commit an error that would result in disaster to the entire army. The individuals of the lower ranks, on the other hand, would be helpless without commanding officers. Each individual, from the lowest to the highest rank, performs an important part in relation to the whole.

In any research work, if each individual had to work alone and without the help and co-operation of others, little could be accomplished. In research work in the X-ray field there are a considerable number of highly skilled electrical and mechanical engineers, chemists and physicists, together with their various assistants, all working together for the common good. The results of research work have already been of profit to us all and promise much more for the future.

The production department has its production manager, engineering department, experimental department, purchasing department, superintendents, foremen, mechanics, with their assistants, all working together to produce the highest quality of equipment at the lowest possible cost. The greater the co-operation in this department, the more satisfactory will be the result.

The educational department has its branches, diagnostic, X-ray therapy, and physiotherapy, each with its director, in-

structors and assistants, whose duty it is to assist in the intelligent and successful use of the various energies and modalities. Here, again, co-operation means everything in the success of the department.

The advertising department consists of a director and his aids, who must have the co-operation of others in order that true and important information may be broadcasted for the benefit of both the purchaser and seller of equipment.

The credit department consists of a director and assistants, who in turn need the co-operation of members of other departments as well as that of the purchasers of equipment, in order that general business conditions may be stabilized for the benefit of all concerned.

The accounting department has its director, bookkeepers, clerks, stenographers and correspondents, who keep account of all business transactions for the benefit of purchaser and seller alike. Here, again, co-operation is the keynote of success.

The sales department has its general manager, assistant general manager, district managers and salesmen, with assistants, providing the connection between the factory and the purchaser of equipment. Its purpose is to sell and to assist the purchaser in the intelligent selection of equipment. In no department is co-operation of more importance than here.

The service department consists of a number of specially trained men who install the equipment and look after any trouble that may develop from time to time. Here again, co-operation with the individuals of other departments, as well as with the user of equipment, is important.

The executive department consists of a chief executive, the president, his secretary and the several associates whose duty it is to correlate and direct, in a general way, the affairs and activities of all the other departments. None works more earnestly for co-operation than this department. In order that the maximum result may be obtained by the major group, it is not only necessary that the utmost co-operation shall exist between the various individuals of each department, but there must also be a like co-ordination of each department with every other.

The duty of the technical group is to execute the orders given by the radiologist, the care of the patient and the operation of the equipment being their chief duties. The technician must co-operate with the Radiologist and with the patient as well. The radiologist decides upon the course of procedure, issues the orders for carrying it out, and sums up and delivers his opinion and advice regarding the end-result. He should co-operate with his technician, and, in turn, have the loyal support of the technician in order that this major group may function most efficiently.

These two major groups—the makers and the users—should support one another and make common cause, to the end of contributing to the welfare of all concerned.

Finally, as individuals, we are all working toward a common end,—the rendering to the patient of the highest service which may be possible.

CASE REPORTS

PRIMARY CARCINOMA OF THE TRACHEA

By KENNETH S. DAVIS, M.D., M.S. in Roentgenology, Saint Vincent's Hospital, Los Angeles, Calif.

Male, 34 years of age, admitted to the hospital complaining of a dry cough of about two years' duration, which was paroxysmal at times. For two months prior to his admittance he had complained of severe attacks of dyspnea, simulating asthma.

Stereoroentgenograms of the patient's chest showed a tumor lying high in the mediastinum, of homogeneous density, the borders of which were sharply defined, smooth and convex. The shadow of the tumor could be separated from that of the arch of the aorta. There was a tendency for the tumor to lie on the right side of the midline, but it did not displace the trachea. In the fluoroscopic examination the tumor did not pulsate, nor did it move during swallowing.

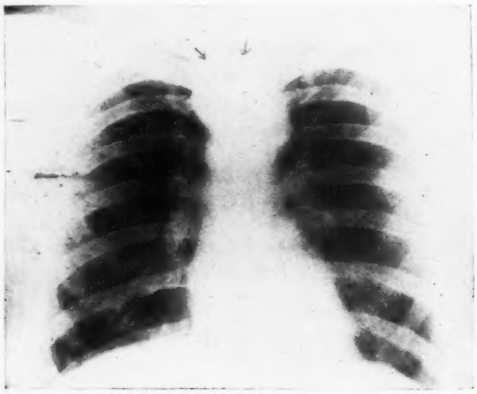

Fig. 1. Roentgenogram of the chest showing a mediastinal tumor lying behind, slightly above, and to the right of the manubrium sterni. In the stereoroentgenograms the tumor could be separated from the arch of the aorta. The borders were smooth and sharply defined. The tumor was apparently of homogeneous density. A tentative roentgenographic diagnosis was made of benign mediastinal tumor, probably intrathoracic thyroid, as the appearance in the X-ray films was typical of this type of mediastinal growth.

Because of its location, density, and the fact that the borders were smooth and sharply delimited, a tentative roentgenographic diagnosis of intrathoracic thyroid was made.

After admission the patient improved so much that he was allowed to go home, but was readmitted two weeks later following a severe attack of dyspnea, with marked cyanosis. Therapeutic measures gave only temporary relief, and symptoms grew progressively worse, until death occurred during one of his attacks.

Fig. 2. Photograph of the tumor found at necropsy, showing a primary carcinoma of the trachea about 1½ inches above the bifurcation. Growth had almost completely encircled the trachea and had invaded the lumen.

During this interval (about two months in all), repeated roentgenograms had been made in which the findings were identical with the first report. There was no increase in the size of the tumor, so far as could be determined in the roentgenograms.

At autopsy, a carcinoma of the trachea was found, having a collar-like appearance as it almost completely surrounded the trachea, except on its posterior surface. There was a fairly large mass on the right side of the trachea, with only a relatively small tumor on the left side. Death had occurred by asphyxiation, and by a terminal bronchopneumonia on the right side, which was demonstrated in a roentgenogram made the previous day.

Discussion: The roentgenographic appearance was that of a benign mediastinal tumor which, from its appearance, location, size and shape, should have been an intrathoracic thyroid, while the autopsy findings (gross and microscopical) were those of a carcinoma.

The case is not only interesting from the roentgenographic but also from the pathologic standpoint.

A CASE ILLUSTRATING THE VALUE OF RADIUM IN RECURRENT CARCINOMA OF THE BREAST

By WILLIAM NEILL, JR., M.D., Baltimore, Md.

Radium is of great value in the treatment of accessible recurrent carcinomata of the breast, as is illustrated by the following case:

Woman, married, white, age 55, No. 8723, admitted to the Howard A. Kelly Hospital, for radium treatment December 8, 1921. General condition as to weight and color, good. The left side of chest presented a circular granulating area 9 x 9 cm., and a number of recurrent nodules protruding through areas partly covered with skin grafts. The condition was an extensive fixed recurrent carcinoma of the left chest wall. The opposite breast, axillary and neck regions, as well as the chest and abdomen, were clear of disease. Wassermann negative. Tissue taken presented a condition of adenocarcinoma.

On April 17, 1919, a radical removal of the left breast and glands of the axilla, which were also involved, had been carried out at the Johns Hopkins Hospital. By means of skin grafts, healing had occurred. Recurrence had appeared, which necessitated removal of the cartilaginous portions of the third, fourth and fifth ribs on the left side. Immediate recurrence had followed, and a further removal of a portion of the ribs and sternum had been carried out September 14, 1921.

Treatment was arranged for so that at a distance of 5 cm. through 1 m.m. brass and 2 m.m. lead a pure gamma radiation was secured over and well beyond the entire involved area. The first treatment was given December 9, 1921, for a total of sixteen gram hours. The area covered was approximately ninety square inches. A mild erythema of the skin and a marked recession of the growth were obtained. On January 7, 1922, a similar treatment was carried out covering but forty square inches, which now included the entire involved area. On February 18, 1922, this same area was treated, receiving a total of ten gram hours at 2½ cm. distance. This was followed by complete healing. However, on July 28, 1922, a small nodule appeared on the inner edge of the scar and was treated at a distance of 2 cm. for one gram hour. This resulted in a disappearance of the recurrence and there has been no further development of either local or general trouble. She was last examined July 10, 1925.

REMARKS

1. Healing was secured in this case without sloughing or burning.

2. The growth was an adenocarcinoma, which is more likely to heal than a hard scirrhous carcinoma.

3. The intermittent radiation employed in this case is less trying on the patient and less likely to produce a burn than the single dose method.

4. In extensive comparisons in parallel series it is our impression that radium gamma radiation is markedly superior to

X-radiation of approximately equal quantity.

5. When the growth is massively nodular the burying of bare emanation points must be added to the technic described above.

FRACTURE OF HUMERUS: NON-UNION

By H. B. PODLASKY, M.D., From X-ray Department, Mt. Sinai Hospital, MILWAUKEE

The following case report may be of interest to industrial physicians from the standpoint of estimating permanent disability. The patient was admitted through the service of Dr. S. H. Wetzler for a hernia operation. During the physical examination an interesting condition of the left humerus was observed.

Non-union is, of course, frequently observed in fractures and the resulting disability is, as a rule, very great. In this patient, however, several attempts at reduction, both by the closed and open methods, had resulted in failure. After thirteen months of attempts at union the patient refused further treatment and went back to his occupation of teamster. After fourteen years of continuous employment with the same company, he has become accustomed to the handling of a pick and shovel so that one finds it rather difficult to observe any deformity or "hitch" in the movements accompanying the use of these implements.

Fig. 2. Position assumed easily; note flexibility at site of non-union.

Fig. 1. Left humerus, palm down, elbow flexed, fragments displaced. Note smoothness of lower end of upper fragment, broken pieces of wire, and new bone fragments.

F. K., age 52, injured May 3, 1911. Team ran away and wagon passed over the man's left humerus. The injury consisted of a fracture of the left humerus at about the junction of the upper and middle thirds. Reduction was attempted. Patient remained in a "sling" for about three weeks, then was put in a cast for two months. This treatment did not result in union. An open operation was then at-

Fig. 3. Limit of upward arm movement.

Fig. 4. Note muscular development around shoulder girdle.

tempted. The fracture was wired and a cast again applied, without union.

Thirteen months after the injury the patient went back to his previous employment as teamster and has gradually developed a pseudo-joint at the site of fracture and well developed muscles of the left arm and forearm.

Roentgenograms and photographs made May 12, 1925.

DEPARTMENT OF RADIODONTIA

UNDER THE SUPERVISION OF BOYD S. GARDNER, D.D.S.,
ROCHESTER, MINNESOTA

THE ADVANTAGE OF RIGID FILMS OF VARIOUS SIZES IN RADIOGRAPHING THE MOUTH

By JAMES A. BLUE, D.D.S., BIRMINGHAM, ALABAMA

REALIZING that the stock films do not adequately meet the requirements in size for properly radiographing the mouth, I began an experimentation with various sizes of films which were cut from regular stock films.

For routine work two sizes have been adopted, numbered, for convenience, 1 and 2. Number 1 is cut from the Eastman Regular Improved film, keeping the same length, 1⅝ inches, and making the width ⅞ of an inch. The side which has been cut is protected with passe partout binding paper (Fig. 1). Number 2 is the Eastman Regular Improved film which is 1⅝ inches by 1¼ inch (Fig. 2). The films are stiffened with metal in the manner shown in Figures 1 and 2.

Fig. 1. The film, ready for use, with a piece of passe partout paper as it is cut for binding, and the metal which is used for stiffening.

Fig. 2. The Eastman regular film, with the metal which is used for stiffening.

Number 1 is advantageously used for radiographing the maxillary and mandibular canines and incisors. Number 2 is used for the maxillary and mandibular premolars and molars.

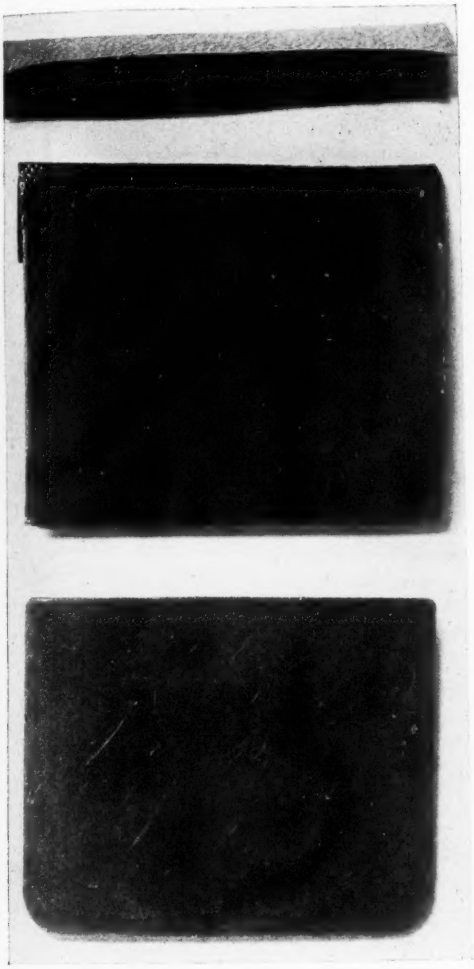

Fig. 3. With the film packet ready for use, the metal stiffening is placed between the red and black papers on the back of the film, before it is bound with the passe partout paper.

In radiographing a full mouth it is well to adopt a standard starting point. A good plan is to begin at the maxillary left, progressing to the right side and from mandibular right to mandibular left. A large cotton roll is placed along the gum margin and the palatal surfaces of the first, second and third molars and held with the left hand, while Number 2 film is placed with the upper margin paralleling the median line of the palate. The film is pressed against the cotton roll and the patient instructed to hold the film with the thumb of the right hand, the film being held rigid with metal, as mentioned above. The upper border of the film should not be allowed to extend to the opposite side of the mouth farther than the median line in any case, as too much elongation will result.

The first molar and first and second premolars are radiographed by placing the cotton roll, as described, above along the gum margin and palatal surfaces of the teeth, and placing film Number 2 in the median line of the palate with the length of the film parallel with the long axis of the teeth, and balancing it on the cotton in a manner such that the first and second premolars and first molar will appear in their entirety on the film.

The canine is radiographed by the use of Number 1 film, using cotton, as previously described, to balance the film in such a way that the canine will appear on the center of the film. Number 1 is also used for the central and lateral, which should appear in their entirety on one film, using the cotton to balance the rigid film.

The right side of the mouth is handled as the left, the films being held by the thumb of the patient's left hand.

The technic for the mandible differs only slightly from that for the maxilla. A Number 2 film is used for the first, second, and third molars, with its length at right-angles to the long axis of the teeth, its anterior margin approximating the mesial surface of the first molar and its depth to within about 3/16 of an inch of its entire width, so that the crowns of the teeth as well as their roots will appear on the film. It is not necessary to use a cotton roll in this region, but if it is used it should be very small. For the premolars and first

molar a Number 2 film is placed with its length paralleling the long axis of the teeth. A cotton roll is used to balance this film. Three Number 1 films are used for the anterior teeth: the first premolar, canine, and lateral should appear on one film, the four incisors on another, and continue to the opposite side in the same way as described above.

In cases where a wider film is desired an Eastman Number 1A is cut to a size which gives us a film 1½ inches by 1⅝ inches and numbered 3 (Fig. 3). This film is especially useful in radiographing the maxillary molars in cases where the vault is very flat, as it permits of elongation of the roots sufficiently to eliminate the malar shadows.

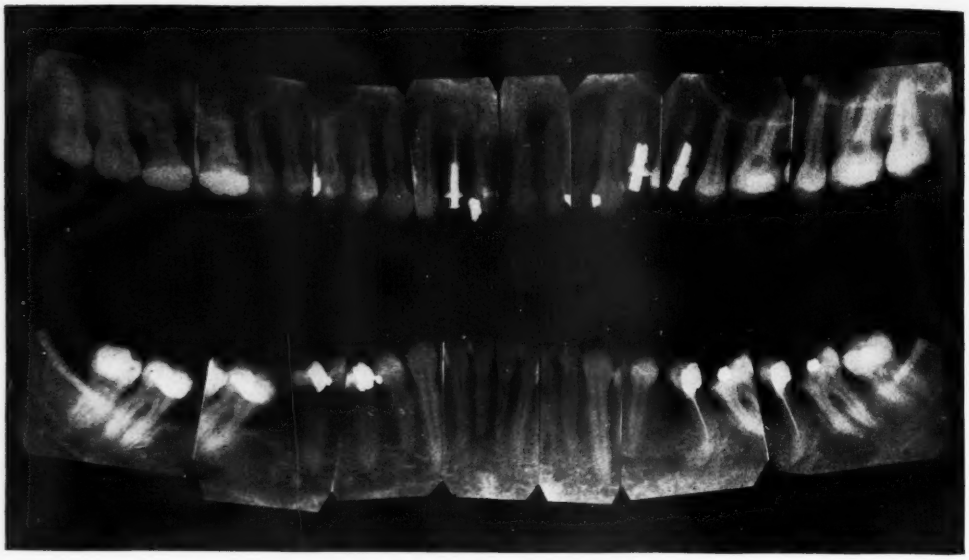

Fig. 4.

As rigid films are used, there will be no distortion if the angles are correct. With care, all root apices and contact points can be shown in the average case in fifteen films. Of course, as much duplication can be made as is desirable (Fig. 4).

EDITORIAL

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SPHERE GAP

The following communication has been received from a member of the technical staff of one of the important X-ray apparatus houses,—a man whose skill entitles him to speak with authority upon his subject.

Why is the sphere gap the standard for measurement of voltage in medical practice?

What are the reasons against the use of point gap for measurement of voltage?

What are the general specifications under which the sphere gap should be built?

These three questions come up frequently whenever roentgenologists are gathered together, and although they have been discussed from time to time in technical literature, perhaps it would be interesting and timely to give such direct answers to the questions as are set forth by our friends, the physicists.

The sphere gap has been standardized for measurement of voltage in medical practice because it is necessary to record, collate and transmit, with the maximum accuracy, information which has to do with the practice of medicine and the welfare of the human body. In the use of X-rays, either for therapy or radiography, the factor of voltage has a direct and vital influence on both the quantity and quality of radiation produced by the tube. It is, therefore, doubly important that the record and transmission of correct voltage should be done with all possible care and accuracy.

In adopting the sphere gap for measurement of voltage, we are following a rule established by the Standards Committee of the American Institute of Electrical Engineers. That rule authorizes the use of a point spark gap for measurements of voltages up to 70 kilovolts, maximum, provided the point spark gap is built and used in accordance with certain standard specifications.

For measurements of voltages above 70 kilovolts, maximum, they prescribe the use of the sphere gap, with the statement: "When used as specified, the accuracy obtainable should be approximately 2 per cent." It might be noted here that tests made recently at Harvard University show an error of even less than 2 per cent in measurements made by means of a standard commercial sphere gap.

The answer to the first question is, then, that the sphere gap is the most accurate known method of measurement of an important factor in medical work and it is, therefore, perfectly logical that it should have been adopted as the standard in medical practice.

As a reason against the use of the point gap, it is perhaps not sufficient to cite the rule of the A.I.E.E., because at once the question would be asked: Why have they made such a rule? There are several reasons against the use of the point gap, not the least of which is the difficulty of constructing and maintaining such a device in accordance with the specifications necessary in order to obtain reasonable accuracy, even for voltages so high as 70 K.V., maximum. For instance, "The needle spark gap should be between new sewing needles,

supported axially at the ends of linear conductors, which are at least twice the length of the gap. There must be a clear space around the gap for a radius at least twice the gap length." It is quite evident that that specification means plenty of room and new sharp needles for each measurement.

The reason for this requirement is that at comparatively low voltage the points in a point gap become surrounded by corona, and as the voltage increases there is, first, a brush discharge which increases with the voltage, and, later, very light crackling discharges which increase in frequency and intensity until finally there is a continuous spark over discharge. There is quite a difference in the voltage at which the first crackling discharge occurs and the final steady spark over. There is, therefore, the error of personal opinion as to when the point gap is really sparking over. With different observers using the same point spark gap, this difference of opinion will amount to as much as 15 per cent.

Variation in the sharpness of the needles will cause variation in the difference of potentials causing the first appearance of brush discharge and final continuous spark over. The invasion of the clear space around the gap by some extraneous object causes a variation in the voltage at which continuous spark over occurs. Finally, because of the fact that energy may be gotten rid of in the brush discharge, the point gap is not sensitive to transient voltages and does not record truly the highest voltage reached at any time.

We have, then, as reasons against the use of the point gap, extreme liability to error due to personal opinion, liability to error due to faulty construction and location of measuring apparatus, and, finally, liability to error due to lack of sensitiveness.

Either the sphere gap or the point gap must be used carefully and properly, but those possibilities of error in the point gap mentioned above do not exist in the sphere gap, which has a definite spark over point, no brush discharge and is extremely sensitive. A check on the effect of these errors made some years ago in one city showed that there was a variation as great as 30 per cent in the voltages recorded by various roentgenologists.

Finally, as to the general specifications for construction and use of the sphere gap. According to the Standards Committee of the A.I.E.E., "The standard sphere spark gap should be between two suitably mounted spheres. No extraneous body nor external part of the circuit should be nearer the spheres than twice their diameter.

"The shanks should not be greater in diameter than one-fifth the sphere diameter. Metal collars, etc., through which the shanks extend, should be as small as practical and should not during any measurement come closer to the sphere than the maximum gap length used in the measurement.

"The sphere diameter should not vary more than one-tenth per cent, and the curvature measured by a spherometer should not vary more than 1 per cent from that of a true sphere of the required diameter." There are certain specifications as to the type of spherometer used for a measurement of curvature. There are specifications for the correction of gap spacing for variations in air density and temperature, and there is a statement that as the sphere gap is more sensitive than the needle gap to momentary rises of voltage, the voltage required to spark over the gap should be obtained by slowly closing the gap under constant voltage or by slowly raising the voltage with a fixed setting of the gap.

The sphere gap must be used with care in order that the greatest possible accuracy of measurement may be secured.

A COURSE FOR RADIOLOGICAL TECHNICIANS

Marquette University, in a one-year course for radiological technicians, is trying to meet a definite need of executives, physicians, and surgeons in the hospital field. This course was given during the past year by way of experimentation, and the present curriculum has been worked out from experience and with the active co-operation of the Milwaukee section of the American Roentgen Ray Society, which had urged the University to establish the course.

THE AMERICAN REGISTRY OF RADIOLOGICAL TECHNICIANS

The course has the approval of the Radiological Society of North America and the American Roentgen Ray Society. These two societies have been active in the organization of the American Registry of Radiological Technicians, which is composed as follows: "A Board of six shall be appointed, each member to serve for three years. There shall be two members of the Radiological Society of North America, one member of the American Roentgen Ray Society, one member of the Canadian Radiological Society, one physician and surgeon recommended by the American Medical Association or American College of Physicians and Surgeons, and one representative of the American Association of Radiological Technicians."

ADMISSION

The requirements for admission to the course are twofold: (1) Graduation from a four-year course in an accredited high school, or its equivalent as attested by examination; (2) graduation from a recognized school of nursing or equivalent training. By "equivalent training" shall be understood practice as a technician for at least two years under medical supervision.

CANDIDACY FOR A DEGREE

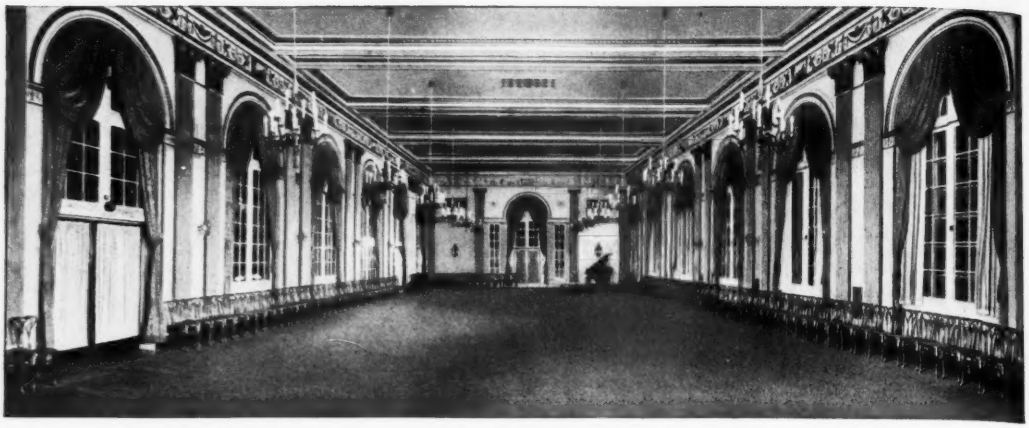
The courses for X-ray technicians may be counted as a year's residence and a year's credit toward the degree of Bachelor of Science to persons who fulfill the requirements of admission to the University and prerequisite training for the courses in radiology and its related sciences. Students in the University with adequate scientific training may elect these courses in their senior year. Graduates of schools of nursing, who are proceeding to the Bachelor's Degree, may also count these courses toward the degree of Bachelor of Science when the usual University requirements are complied with.

COURSES OF STUDY

The course of study for radiological technicians will cover one year of the full time of the student. The first semester will deal largely with the fundamental sciences of Anatomy, Physiology, Physics, and Pathology, with courses on radiological equipment and appliances. The second semester deals largely with the radiological technic, procedures, and therapy. Beginning in January, and extending until June 1, four hours each day for six days a week will be given over to actual laboratory practice. Courses on the ethical and legal aspect of practice will also be given in the second semester.

First Semester. — Elementary Physics, Radiological Equipment and Appliances, Principles of X-ray Technic, Elementary Anatomy, General Physiology, and Pathology.

Second Semester. — General Technic, Dark Room Technic, Special Problems, Radiological Therapy, Special Procedures, Laboratory Practice, Ethics, and Legal Problems.



Ballroom of the Hotel Cleveland, where the Scientific Sessions of the Annual Meeting are to be held, December 7-11. The acoustic properties of this room are excellent—a fact much to be appreciated by members.

THE CLEVELAND CONVENTION

December 7-11, 1925

The officers of the Society have selected the headquarters for the next Annual Meeting at the Hotel Cleveland, located on the Public Square at Superior Street, Cleveland. It is a new hotel and it would seem that there the members and visitors will be housed most conveniently and comfortably. There are manifest advantages in having one's room under the same roof as the scientific sessions and exhibits, and all those canny enough to make reservations in advance will be sure of missing nothing of the comradeship which is assured where members of the Radiological Society of North America foregather.

If you have not received a rate card from Mr. Bonneville, the Assistant Manager of the hotel, send him a note and he will take care of the matter of a reservation for you.

DETECTION OF FOREIGN OBJECT IN THE EYE

A case recently tried before the Supreme Court of Wisconsin presents points of peculiar interest to roentgenologists, in that the case turned upon the failure of a specialist in diseases of the eye, ear, nose, and throat to employ or cause to be employed means to determine the presence of a foreign body in the eye. The plaintiff sustained an injury in November, part of a steel spring striking across one of his eyes. Within a few hours he put himself under the care of the defendant, known as a specialist in the treatment of such cases, described the manner of the injury, and stated that he believed that a piece of the steel was embedded within the eye. The defendant, upon examining the eye by means of the ophthalmoscope, direct illumination, and oblique focal rays, stated that, while he found a scratch across the center of the cornea, in his opinion the cornea was not perforated, nor had the eye sustained any internal injury. As the pain did not cease, the plaintiff visited the defendant for further treatment on the next day, and again upon the second day following. At neither of these visits did the defendant make further examination to determine if a foreign body had penetrated the cornea, but assured the plaintiff that the pain and the sensation he described himself as experiencing in the eye was caused by the scratch. Twice in December and once in February the plaintiff presented himself for treatment, and upon the last of these occasions the defendant found an opacity in the lens. Later in February the plaintiff made frequent calls

at the office of a surgeon who specialized in eye operations, and at each such visit the eye was subjected to an examination with the ophthalmoscope, much in the manner that the defendant had done in the first place. The result of these repeated examinations was the discovery of two opacities in the lens of the eye. Upon the 26th of February the eye surgeon caused roentgenograms to be made which revealed the presence of a foreign body in the eye. At operation, a piece of steel was removed by the use of a magnet. Later, a needle operation was performed, and, finally, late in June, the lens of the eye was removed.

The court ruled that the defendant was negligent in failing to avail himself of the use of the roentgen ray in the case. His failure to locate the foreign body by means of the ophthalmoscopic examinations did not constitute negligence, especially as the surgeon experienced a like failure, but his negligence, the court stated, lay in his neglect of a means, known to him and to other practitioners, proven to be of value in the determination of foreign bodies in the eye.

At jury trial the plaintiff was awarded two thousand dollars, but the Supreme Court affirmed judgment upon condition of his accepting the sum of five hundred dollars only, these damages being awarded for the suffering he had been caused to undergo, and not for the loss of his eye. The testimony of experts was that the injury to the eye took place when the object penetrated it, and not upon its removal; that the magnet operation, whenever performed, will be followed by a cataract, which will, in turn, make necessary the removal of the lens of the eye.

COMMUNICATION

August 20, 1925.

Dr. C. G. Sutherland, Librarian, Radiological Society of North America, Mayo Clinic, Rochester, Minnesota.

Dear Doctor Sutherland:

We are much indebted to you for the very fine collection of films sent for exhibition at our International Congress.

Unfortunately, they only arrived after the Congress had opened and I was unable to exhibit them as advantageously as I should have liked and as they deserved.

If I may retain them till the autumn I should like to set them out for exhibition at our first autumn meeting of the Institute.

The Congress was a great success and we were especially pleased to welcome many of your colleagues.

If at any time you propose visiting this country or if you know of others so proposing, I trust you will advise me, as we are anxious that the Institute should be of service to visiting radiologists from any other country and particularly to our American cousins.

Believe me,

Yours very sincerely,

(Signed) F. McLean.

BOOK REVIEW

Cancer and the Public. By Charles P. Childe, B.A., F.R.C.S., M.R.C.P.E., President of the British Medical Association, 1923, Chairman of the Health Committee, Borough of Portsmouth; Consulting Surgeon, Royal Portsmouth Hospital. Two hundred and sixty-seven pages. E. P. Dutton and Co., New York. Price $4.25.

This timely publication, intended primarily for the intelligent layman, is a noteworthy contribution to the educational program for the control of cancer. The author has admirably fashioned the facts and knowledge of a medical subject in a manner quite understandable to the average layman, and one which contains no horrors and no distressing details calculated to throw the reader into a panic. The medical reader is certain to be impressed

by the sane and unbiased manner in which the subject has been treated.

The author discusses fully the historical beliefs concerning the cause of cancer as well as the commonly accepted fallacies about the symptoms and course of the disease. He shows that where the disease is treated in time a remarkably high percentage of cures can be obtained, but that, owing to its inception and earlier stages being practically painless, the great and universal danger is that it is neglected until it ceases to be a local disease. The symptoms in the earlier stages are described in non-technical language, the danger signals emphasized, and prompt attention to them urged.

JOHN D. CAMP, M.D.

ABSTRACTS OF CURRENT LITERATURE

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Diaphragmatic hernia. — The bibliography of this deformity is traced from Ambroise Paré, who in 1610 described two cases due to trauma, down to date. Morrison (in *Jour. Am. Med. Assn.*, 1925, LXXXIV, 161) is given the credit for pointing out the method of diagnosis by means of roentgenology. The classification, according to Richards, into three groups, is followed: I. True hernias (those with hernial sac); II. False hernias (those without hernial sac), and III. Eventration of diaphragm. The locations of diaphragmatic hernia are, furthermore, described under Anterior, Costal, Posterior, Esophageal, and "Other Situations." It is with the esophageal type that this paper is concerned.

The authors report six cases of diaphragmatic hernia of the cardia of the stomach through the esophageal orifice, in which the diagnosis was definitely established by means of the roentgen ray, which presents a characteristic finding. The patient is first fluoroscoped in the upright posi-

tion, the opaque meal being observed as it descends through the esophagus. A slight retardation may be noted at the cardia, the lumen of the esophagus, however, appearing normal. In the recumbent position, even, the hernia through the esophageal orifice may not become visible until the patient takes rapid and deep breaths, or strains. Then on expiration the opaque meal may be noted to pass back into the stomach below the diaphragm.

The symptoms produced by these hernias suggest gastric ulcer or cholelithiasis and occur more often when the patient lies down after eating. The form of thoracic stomach described by LeWald must not be confused with this type of hernia. In the condition described by the authors the esophagus is shortened and does not pass through the esophageal orifice, while the stomach remains constantly in the thoracic cavity. In establishing the differential diagnosis the following procedure in the course of the roentgen-ray examination is held by the authors to be of great importance: With the patient recumbent, taking the barium meal through a straw, the observer may ascertain the relation of the herniated fundus of the stomach to the esophagus, which will be seen to be on either side or posterior to the hernia. "At times a small circumscribed dilatation at the cardiac orifice of the esophagus will simulate this condition. However, under the fluoroscope the dilatation is observed within the esophagus and above the diaphragm, while the patient remains recumbent. Obstruction may be present, though this condition was not observed in a case presenting a small dilatation, in which the shadow was situated directly above the diaphragm, resembling a hernia in many respects. Again, when patency of the cardio-esophageal opening occurs, which is also best noted in the recumbent posture, the opaque meal will be observed to pass up the esophagus on deep inspiration, the stomach appearing below the diaphragm. A diverticulum at the lower end of the esophagus may also be confused with this form of hernia."

Report of an Interesting Type of Diaphragmatic Hernia of the Cardia of the Stomach through the Esophageal Orifice. Julius Friedenwald and Maurice Feldman. Am. Jour. Med. Sciences, Aug., 1925, p. 263.

Barium sulphate plaster. — Numerous experiments were made with various mixtures of barium sulphate powder, Portland cement and sharp sea sand. These all proved of little value for roentgen protection, since either the large amount of sand present rendered the barium content so slight that sufficient protective value was not afforded, or where a large amount of finely powdered barium sulphate was used, the resulting plaster was so brittle that large cracks would appear on drying.

Where barium sulphate sand (95 per cent barium sulphate) was used as a substitute for ordinary sand, both of these objectionable features disappeared. Barium sulphate sand is a hard, coarse, inert material, which, when combined with Portland cement, makes a plaster, which, on drying, is almost as hard as concrete.

The plaster should be composed of Portland cement, pulverized barium sulphate, and coarse barium sulphate sand, thoroughly mixed and applied in coats not to exceed one-half inch each. Each coat should be scratched and allowed to dry before the next coat is applied. The cement and barium should be mixed dry and sufficient water added to make a workable mortar. The under coats should be composed of 1 part Portland cement, 1 part fine barium sulphate, and 2 parts barium sulphate sand. The finish coat should be composed of 1 part lime putty, 1 part plaster of Paris, and 1 part fine barium sulphate.

The partitions are made solid, 2½ inches thick, plaster applied to a construction of light steel channels covered with metal lath on each side. This plaster can be applied directly to wood or metal plaster lathing and if thick should be applied in several layers.

Measurements made of such a wall showed it to be equivalent approximately to ¼-inch of lead for 200 K.V.

JOHN D. CAMP, M.D.

Barium Sulphate Plaster for Protection against Two Hundred Thousand Volt Roentgen Rays. L. R. Sante and Tracy Hinkley. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 383.

Oral administration of gall-bladder dye. — The sodium salt was used because its free solubility would favor absorption. Bicarbonate of soda was given with it to prevent precipitation by the hydrochloric acid of the stomach. The dose was approximately 0.1 gm. per kilogram of body weight up to 70 kilograms. This is divided into capsules containing from 0.5 gm. to 1 gm. each. Two of these are given at the beginning of the evening meal, two during the meal, and two at the end. Nothing is given by mouth the following morning until after films have been made. Films are made at 12–14 hours, 18 hours and 24 hours after taking the drug. The greatest size of the gall-bladder shadow is usually reached on the 12–14 hour film, while the 18 and 24 hour films show a smaller and denser shadow. Following the taking of food

there is generally a distinct decrease in the size of the shadow.

The authors have administered the drug 37 times to 32 patients. All of these showed gall-bladder outlines except four. All but 12 have had some sensation of nausea or discomfort in the stomach, beginning about an hour after taking the dye. Vomiting occurred 10 times. Several had a slight looseness of the bowels on the following day. The urine was consistently negative and several attempts to recover the dye from it failed.

Recently the authors have been using gelatine capsules hardened by exposure to formaldehyde. These are not dissolved in the stomach, and all of the dye reaches the small intestine without being acted on by the hydrochloric acid of the stomach. When given in this manner none of the dye is precipitated as the insoluble acid, and the dose may be reduced to 75 mg. per kilogram of body weight.

JOHN D. CAMP, M.D.

Oral Administration of Sodium Tetrabromphenolphthalein—Preliminary Report. Thomas O. Menees and H. C. Robinson. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 368.

Tuberculous adenitis. — The authors conclude that both surgery and roentgen-ray therapy have important places in the treatment of tuberculous adenitis. In reporting a series of twenty-one cases—a series "too small to include all types of cervical gland tuberculosis"—classification is made in three groups: (1) Cases with limited involvement, for the most part early. This includes those most favorable for operative treatment. (2) Cases with scattered nodes with or without small abscess formation. This group, the largest of the three, is less favorable for operative excision. (3) Cases with large abscess formation or otherwise too extensive to be treated by radical surgery. The five cases in Group 1 are reported in detail, and the condition at examination, the number and duration of roentgen treatments, and the end-results in all the groups are tabulated.

In a résumé of the literature J. M. Hanford is reported as having treated a series of 141 cases with relatively frequent small doses of filtered roentgen rays in which 70 per cent showed "either apparent cure or such marked improvement as to justify conservative treatment." C. N. Dowd's report of 91 per cent of cures from operation "would be hard to surpass," whatever the method of choice. The object of this study is to estimate the value of roentgen-ray therapy as compared with excision in treatment of tuberculous adenitis. "Surgical experience, as expressed in such reports as that of Dowd, has shown that in early cases with a localized mass of involved nodes, excision gives a high percentage of cures. In such cases, permanent cure by the roentgen ray is frequently possible, but seems less certain. The possibility that large firm nodes will break down under roentgen-ray treatment must be considered. In choosing the method of treatment for such an individual case, the uncertainty and tediousness of radiotherapy must be weighed against the operative risk and resultant scar after surgical procedure. There are, however, other cases (three-fourths of our series) in which complete excision is impractical or impossible, many of which can be definitely cured by the roentgen ray. It is not always a question of choice between surgery and radiotherapy, as incision and aspiration are surgical procedures indispensable to success in many cases in which the roentgen ray is used."

Radiotherapy in the Treatment of Tuberculous Cervical Adenitis. Morris K. Smith and J. Gardner Hopkins. Jour. Am. Med. Assn., July 25, 1925, p. 262.

Experimental studies of gastric mucosa. —Pawlow pouches exposed to roentgen rays show hypochlorhydria, followed by achlorhydria. The dose necessary to produce this effect on the acid secretion is from 155 per cent to 200 per cent of a dog erythema dose. The reduction and eventual disappearance of acid from the gastric juice is associated with definite injury to the gastric mucosa.

The most striking injury occurs in the superficial portions. Mucous, neck, chief and parietal cells are damaged. The chief cells undergo cytolysis, while the parietal are not so easily broken down. Persisting parietal cells which show no histologic evidence of injury are unable to produce mucus.

The mucosa shows passive hyperemia. There is no infiltration of white blood cells. The fibroblasts do not respond rapidly and no fibrosis is found. No phagocytosis was observed and the necrotic tissue is apparently sloughed, regeneration occurring from below.

In regenerated mucosa the thickness is markedly reduced but the structure is histologically normal. The parietal cells show marked variations in staining and in nuclear structure. Some cells are pale with a pycnotic nucleus, while others stain densely and their nuclei show a definite reticulum. These differences are not so pronounced in normal mucosa.

The delay in healing in these injuries is probably dependent on the sluggish reaction of the fibroblasts, since there can be no epithelial re-

pair until a healthy connective tissue substratum is established.

JOHN D. CAMP, M.D.

Histological Changes in the Gastric Mucosa (Pawlow Pouch) of the Dog, Following Irradiation. Alden B. Dawson. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 320.

Malignancy of ear, nose, and throat.—The author first sets forth the nature of electrocoagulation, how it differs from cautery, the reactions caused by it, and the results attained by it. In a like manner radiation is considered, both by radium and roentgen ray, emphasis being laid upon the fact that the laws governing the values of each form of radiation must be kept in mind constantly. "All radiation must be carefully measured, and the depth values and cumulative effects carefully calculated. Otherwise there will be insufficient radiation, and the treatment will fail; or there will be an excessive effect, and damaging results will follow."

Malignancy of the ear is considered as (*a*) confined to the skin, or (*b*) extended into the cartilage. Primary malignant disease of the middle ear is rare, the author states, quoting statistics. A case is reported, the dosage employed being given.

In malignant disease of the nose and antrum the author emphasizes that the origin of the disease and its extent should be determined by means of all possible clinical examinations, especially by roentgen-ray study, before the form of treatment—whether radium, cross-firing with high voltage roentgen rays, or electrocoagulation—is fixed upon. He believes that if a diagnosis can be made without an operation or removal of a section, it is better. "Even if there were no danger of spreading the disease, such an operation surely interferes with the treatment, by increasing the tenderness and swelling in the neighborhood of the operation." A report of a case of carcinoma filling the left antrum, where palliation, if not actual cure, has been secured, is given. As before, Dr. Pfahler states the technic employed.

In fibromas of the nasopharynx he believes, with New and Figi, that radiation gives the best results. He quotes these authorities as saying that "Radium is the treatment of choice for fibromas of the nasopharynx. With its use the usual operative mortality in these cases is eliminated. In most of our cases the tumor cleared up entirely, and in the others it was held in check during its period of activity." In Dr. Pfahler's opinion electrocoagulation has no place in the treatment of sarcoma of the nasopharynx. "It is not practical to destroy all the disease, and there is great danger from secondary hemorrhage. These sarcomas yield very well to radiation, and with no great inconvenience, suffering, or distress on the part of the patient. The gamma rays should be applied to the surfaces of the pharynx, post-nasal space and tonsils, and high voltage roentgen rays should be applied externally. Even roentgen rays filtered through only 6 mm. of aluminum have produced brilliant results."

Carcinoma of the tonsil in any stage is best treated by irradiation,—the earlier the better. "When a diagnosis can be made, I believe that an operation should be avoided. Brilliant results may be expected, if treated early. When the disease has extended sufficiently to produce palpable disease in the lymph nodes, we may expect palliative results, but probably not cure." The author quotes G. W. Grier as advising that the cervical region on the affected side be treated by high voltage roentgen rays, a dose being administered that will produce a well defined erythema, and that radium needles or emanation tubes be inserted into and around the tumor, after an interval of about three days. The author's best results have been attained by local surface application of gamma rays, combined with external treatment with high voltage roentgen rays, the radiation being carried to the erythema dose internally and externally, and then kept at this saturation point for from ten to fourteen days. He advises the use of the tonsil clamp, "slightly modified so as to hold the radium on the inside (where a sponge is ordinarily applied)."

In carcinoma of the larynx the author quotes Novak and Régaud, both of whom have had marked success in treatment. The latter authority gives his technic. "The larynx," the author states in conclusion, "especially the arytenoid cartilage, is especially sensitive to radiation, and, therefore, one cannot use massive or excessive dosage, or edema of the larynx and strangulation may result."

Electrocoagulation and Radiation Therapy in Malignant Disease of the Ear, Nose, and Throat. George E. Pfahler. Jour. Amer. Med. Assn., Aug. 1, 1925, p. 344.

The benign prostate.—A study of the statistics of cases of obstruction to urination concludes with the statement that there is an apparent increase in the number of these cases coming to operation. The former belief that gonorrheal infections predispose to prostatic hypertrophy is dismissed by the author as without foundation in fact. The position of the obstruction in relation to the orifice depends on which lobe or glandular group is chiefly involved. The size of the hypertrophy varies from a small lobular tumor, pedunculated or not, to masses the size of an orange. In many instances

the smaller tumor which can not be felt per rectum, causes greater urinary difficulty than the large globular masses. Immediately surrounding these adenomatous masses, there is a ring of compressed prostatic tissue, forming the so-called glandular capsule, usually the seat of round-cell infiltration and chronic passive congestion. The author states that "it is the temporary relief of this congestion, brought about by many non-surgical therapeutic measures, that raises the false hope of a cure by these methods. In the operative treatment of obstructing prostate, the adenomatous masses are removed and the glandular capsule left behind." Obstruction once begun, there follows a compensatory hypertrophy of the bladder. As long as the bladder can empty itself, only irritative symptoms will develop. With the increase of the obstruction, however, this compensatory hypertrophy is gradually overcome and residual urine collects. With the increase of this, which may reach as much as several quarts, the uretero-vesical orifice is rendered incompetent, and a slow dilatation of the ureter, resulting in hydro-ureter, takes place. In time this reaches the kidney and produces hydronephrosis. "Sooner or later," the author continues, "infection is added to the already damaged urinary tract, and the combination of back pressure, plus infection, produces serious and permanent damage to the kidneys. As a result of renal sepsis and absorption, the general health becomes impaired, the digestion deranged, the cardiac muscle degenerates, and the vitality is so lowered that surgical intervention becomes a serious procedure."

Various drugs have been recommended to reduce the size of the prostate, but Deaver is quoted as saying that very few drugs are of any permanent value. The author has found viburno satisfactory in congestive disturbances, if used for a considerable period of time. Ergot, with or without cascara, acts in much the same way. There is no question as to the value of X-ray and radium in the treatment of both acute and chronic infections, in checking the growth and causing a shrinkage of the neoplasm. In addition, the old but efficient prostatic massage, combined with hot sitz baths or hot rectal douches, must not be forgotten. Bumpus is quoted as to the experience of the Mayo Clinic with radium, as follows: "Its great field of usefulness is in checking bleeding in those cases which present this damaging symptom. In cases of marked prostatic enlargement, with considerable residual urine, the results obtained were very disappointing. In cases of slight prostatic enlargement, with little or no residual urine, radium seemed to relieve obstructive symptoms and reduce the residual urine, and in certain cases seemed to check the progress of the disease."

Opinions as to the value of X-ray vary from those of Oppenheimer and Haret that "in the early stages the results are sometimes surprisingly good, but the effects are apt to be transitory," to that of H. B. Philips that "so superior and so much safer are the results achieved by the use of the X-ray, when compared with the results of surgery, that in my judgment all cases should have a course of X-ray therapy first—surgery to be used only when radiation has failed to relieve obstruction and allay annoying symptoms." The author's opinion is that "there can be no question but that some of the results obtained by radiation are very satisfactory, and possibly the urologists, regarding the condition as surgical, do not radiate their cases as intensively as they might."

The conditions under which operation is advisable and safe, considering the age and occupation of the patient, are considered at length. "In view of the present status of surgery, it is only rarely that a case should be advised to start catheter life." In discussing the best method of removing prostatic obstruction by surgical measures, the author says: "Probably three-fourths of the benign prostates of size sufficient to necessitate operative removal can be removed equally well, with just as great safety and with good functional results, by either method of approach, provided the operator is equally skilled in either method." The suprapubic and perineal methods of approach are considered, as well as post-operative hemorrhage, and such complications as urinary fistula, hernia, and epididymitis. The author concludes that "the wisdom of the advice, so often given, to wait, to palliate, and submit to operative procedure only as a last resort and after permanent damage is done, is questionable."

The Problem of the Benign Prostate. Ernest O. Swartz. Cincinnati Jour. Med., August, 1925, p. 272.

Hypernephroma.—The lesion is nearly always a purely destructive one, quickly eroding the bone and involving the soft tissues. There is no new bone formation. The tumor may be very vascular, giving a definitely expansile pulsation, and when located in the sternum may clinically be mistaken for aneurysm. Spontaneous fracture through a metastasis may complicate the picture of a purely destructive lesion by reason of the new bone laid down in the process of repair.

Metastases are usually multiple, but there are several authentic cases showing a single metastasis only. Any bone in the body may be involved, but metastases distal to the humerus and femur are infrequent. The disease may occur

at any age, but is most common between forty and sixty.

Foremost among those conditions from which metastatic hypernephroma must be differentiated are osteogenic sarcoma, hypoplastic metastases, Ewing's tumor, multiple myeloma and osteitis fibrosa cystica.

JOHN D. CAMP, M.D.

Metastatic Manifestations of Hypernephroma in Bone. Richard Dresser. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 342.

Abnormal ureters.—The abnormal ureters in the author's series of 941 examinations demonstrate (1) strictures, (2) obstructing calculi, and (3) a relatively small group where the uretero-vesical valves are held open and patent —the so-called "golf hole orifice." Strictures resulting in a narrowing of the lumen from either intra- or extraureteral causes, are encountered most often in the extreme upper and in the lower or pelvic portions of the ureter. The upper lesion is usually produced by (*a*) kinking of the ureter from an aberrant or anomalous renal vessel, as a rule associated with a certain degree of ptosis of the kidney (Another prolific cause of this condition is due to the fact that the fascia which binds the upper ureter to the back has failed to lengthen along with prolapse of the kidney. In the opinion of the author the term "ureteral kink" should be reserved solely for those cases which exhibit dilatation only, and that above the site of angulation.); (*b*) ureteritis, and often periureteritis, with adhesions, these conditions being an extension of a pyelitic or a pyelonephritic process; (*c*) calculi which act as a ball valve.

The middle ureteral obstructions are most frequently due to inflammatory changes within, or to calculi.

The lower ureteral changes include the majority of ureteral calculi. Also, by virtue of the close association with certain pelvic organs, the lower ureters are more subject to involvement by extension of inflammatory processes along the pelvic floor.

JOHN D. CAMP, M.D.

Ureteral Variations, with Associated Kidney Changes. Douglas J. Roberts. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 353.

Substernal thyroid.—A majority of intrathoracic goiters are undoubtedly adenomatous, a few are cystic, a few are colloid and a few are of the exophthalmic type. The first and last are usually quite amenable to irradiation. Colloid and cystic tumors are entirely unaffected by such treatment. It is, therefore, important to differentiate between these types before advising roentgenotherapy. It is best to treat no case of substernal thyroid unless there is an increase in the metabolic rate.

The amelioration of symptoms is out of proportion to the decrease in size of the tumor. Cases showing a marked relief from their pressure symptoms will present no recognizable decrease in the size of the tumor as demonstrated on roentgen films made before and after treatment.

Of twenty-four cases treated only three received deep therapy. The results in these three cases were much better and the response much quicker than anything obtained previously. One or two treatments with deep therapy technic is sufficient to give marked relief. The factors used were, 200 K.V., 4½ ma., 20-in. distance, filters, 0.75 mm. Cu. and 1 mm. Al., time 90 min. This represents an 80 per cent erythema skin dose when given over one area 10 cm. square. The depth dose is about 75 per cent in the average case when two areas are treated, one anterior and one posterior. As there is no advantage in treating the neck the treatment should be confined to the mediastinum, and the function of the cervical thyroid thus will not be interfered with.

While irradiation offers no particular danger in the application of the treatment, the chances for complete recovery are obviously not so good as where the mass can be removed. If after careful examination of the patient and a study of the location and extent of the tumor, the internist and surgeon decide that an operation can be successfully performed without risk to the patient, surgery should be the method of choice. If not, irradiation offers a probability of relief from symptoms in a majority of cases.

JOHN D. CAMP, M.D.

Is Irradiation a Satisfactory Treatment for Substernal Thyroid? G. W. Grier. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 327.

Filters.—The absorption of beta and gamma radiations in several metals has been determined. Then the absorption in tissue or tissue substitute of beta and gamma radiation transmitted by a wide range of thicknesses of these metals was measured. This was correlated with biological information obtained from numerous skin tests, using the threshold erythema as an indicator. From this an empirical relation has been worked out between ionization measurements and skin doses for radiation delivered by filters of various metals.

This relation gives a method for determining the erythema dose for any filter, based on the results of physical experiments. The data given enable the radiologist to figure out doses for

many filters. With the aid of data already published, the determination of millicuriehour doses can be extended to include applicators of various sizes and shapes, as well as different distances from the skin.

JOHN D. CAMP, M.D.

Comparison of Different Metallic Filters Used in Radium Therapy. Edith H. Quimby. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 330.

Study of prehistoric bones. — This study was made on a collection of over five hundred skeletons in the museum at Ohio State University. The investigation was undertaken to determine if an extinct race, apparently having had no contact with later tribes and the white race, would show the same pathological conditions as are found to-day.

The abnormalities found grouped themselves into three general classes: diseases of bone, fractures, and arrow and spear wounds.

Definite gross and roentgenological evidence of syphilis was found in three skeletons. They presented varying degrees of involvement, from a simple periosteal thickening and roughening on the crest of the tibia to thickened ivory-like bone invading the medullary canal with gumma formation. Two others were strongly suspicious and several more showed a possibility. Two specimens were found that strongly resembled Pott's disease. In both there had been a flattening out of the bodies of the vertebræ, absorption of the cartilage, and complete fusion of the bodies, with angulation. Several bones found showed the characteristic changes of osteitis deformans. Many specimens of hypertrophic arthritis were observed. Bone infections were very few. The only joint discovered was of the elbow, with complete destruction of the articular surfaces of the humerus, radius, and ulna.

Six fractures, including the clavicle, radius, femur, tibia and fibula, and skull, were found. Numerous bones exhibiting fragments of arrows and spear points were observed.

JOHN D. CAMP, M.D.

A Roentgenological Study of the Skeletal Remains of the Prehistoric Mound Builder Indians of Ohio. Hugh J. Means. Am. Jour. Roentgenol. and Rad. Ther., April, 1925, p. 359.

Roentgen localization of lung lesions.— The practical value of the roentgen-ray localization of a lung lesion depends on the possibility of describing its position in relation to landmarks, either natural or those made by opaque markers, and the availability of such information to the surgeon. The Hirtz compass, originally designed to record this information in the case of foreign bodies, has been adapted, a hollow needle being substituted for the indicator rod when used for lung abscess localization. The authors describe and illustrate the construction of the compass and the method of making use of it, and report three cases in which it was employed with success, the operator being enabled to enter the cavity of the abscess with the exploring needle at the first attempt. Though they are able to describe certain sources of error to be avoided, their experience with the compass is still to limited for them to say that these are the most serious sources of error. However, it appears to them to offer promise in increasing accuracy of surgical attack on those cavities within the lung the walls of which present clear-cut roentgenographic shadows.

Localization of Lung Abscess by the Roentgen Ray, with Special Reference to the Use of the Hirtz Compass: Preliminary Report. L. R. Sante and E. P. Lehman. Archiv. of Surg., Sept., 1925, p. 394.

Iniencephali.—There have been but 38 iniencephali recorded in all medical literature. The specimens which have been X-rayed showed the characteristic occipital and spinal defects. The occiput is fused to the vertebral bodies as far down as the lower dorsal or even the lumbar or sacral regions. Lordosis is evident in all cases, and the fission of the vertebræ posteriorly can be plainly seen in all the cases. These monsters are usually born dead and prematurely. The majority of them are females. Nothing is known as to the cause of the abnormal development. The amniotic theory—pressure due to a lack of fluid—is preferred by most of the authorities. Apparently, the primary condition is a fissuring of the spine, the failure of closure of the vertebral arches appearing to be caused by a dorsal displacement of the occiput.

Iniencephalus—A Cause of Extreme Dystocia. W. A. Newman Dorland. Surg., Gynec. and Obst., Aug., 1925, p. 180.

Fetal monstrosity.—The authors report an unusual form of this rare fetal monstrosity, in which only the head-end of the fetus developed. Not more than six cases of this form have been reported in the literature. They collected from the literature 45 cases of fetus amorphus in man and 16 cases in lower animals, and added their own case. The roentgenographs of their specimen showed it to contain bony structures which appeared to be a rudimentary base of the skull and three vertebræ, the lowermost ending in a knob-like projection. There was a rudimentary eye and a very small mass of brain or spinal

cord in addition to the bones. Of the 46 human cases of fetus amorphus the results of X-ray examinations have been published in seven cases.

W. A. NEWMAN DORLAND, M.D.

Fetus Amorphus. J. P. Simonds and Guy A. Gowen. Surg., Gynec. and Obst., Aug., 1925, p. 171.

Maxillary sinus disease.—The opinions of various observers differ radically as to the value of transillumination and X-ray in diagnosis of maxillary sinus disease. Watson-Williams states that transillumination was discontinued at the British Royal Infirmary because of its unreliability. Dutrow considers the X-ray of greater value in diagnosis than transillumination. Shambaugh believes that little can be added by the X-ray that is not shown by transillumination. Law explains the negative clinical findings after positive roentgenograms by the statement that in the interval between the X-ray and clinical examination, the patient has drained both the antra and the ethmoids by blowing his nose. He is of the opinion that, if the X-ray shows an opaque antrum repeatedly, in spite of negative findings by the irrigation test, one can be absolutely assured that the antrum is full of polypoid tissue.

The author, using a method of transillumination whereby the light is transmitted from behind the intra-orbital ridge through the floor of the antrum, has come to the conclusion that both roentgenography and transillumination are of the greatest value in diagnosing sinus pathology, especially in maxillary and frontal sinus disease. The X-ray is superior to transillumination in outlining the anatomic relations, showing foreign bodies, such as unerupted teeth, and perhaps in detailing shadows of chronic thickening of mucous membrane and bony walls. Transillumination, however, in the writer's hands, is more reliable in acute infections and is more apt to give evidence in cases of retained antral secretion. Were he limited to the use of only one of these methods, he would choose transillumination.

SOLOMON FINEMAN, M.D.

The Comparative Value of Transillumination and Roentgenography in Diagnosis of Maxillary Sinus Disease—Author's Methods—H. H. Briggs, Annals Otol., Rhinol. and Laryngol., June, 1925, p. 485.

Reduction of fractures.—Improved operative technic making the open reduction of fractures a comparatively safe procedure, and the X-ray, must stimulate the ambition of the surgeon whose aim is to obtain perfect functional and anatomic results. The author does not advocate the open method in every case of fracture; in four years he has applied it in only eighteen out of over two hundred fractures, and in practically all these it has been applied only after the closed or other methods of open reduction have proven unsuccessful. He feels, however, that open reduction by the method which he describes should be resorted to more often. This method, he claims, differs from others in that the fragments are not held together by foreign bodies of any kind; periosteum or muscles are not sutured; blood vessels, unless very large, are not ligated (on the contrary, free oozing of blood in the wound is not stopped); all loose bone fragments are removed; the fractured fragments are placed in their anatomic position by properly enwedging one fragment into the other and are maintained in this position by a well fitting special window cast. It is the "one hundred per cent no-foreign body method." The technic is described in detail and fully illustrated.

The No-foreign Body, Tight Fitting Window Cast Technic in Open Reduction of Fractures. A. L. Soresi. Jour. Bone and Joint Surg., April, 1925, p. 289.

Circulation of the extremities.—This brief paper is a further report of investigations, described in a previous paper (Jour. Am. Med. Assn., Vol. 82, p. 1016), of methods of determining the degree of deficiency of the circulation in tissues and the site and extent of arterial obstruction. If the first method described, a modification of the well-known Moszkowicz test, demonstrates the presence of arterial obstruction, the exact site and extent can be determined by injection of sodium iodid into the arteries and by roentgenologic examination. Briefly, this is done by exposing the primary artery of the extremity to be examined, applying a clamp to it and injecting a concentrated solution of sodium iodid into the artery distal from the clamp, a roentgenogram being made immediately afterwards. The detailed technic is given in the article mentioned above.

New Methods for Study of Diseases of the Circulation of the Extremities. Barney Brooks. Jour. Bone and Joint Surg., April, 1925, p. 316.

Coxa vara. — The condition so named by Kocher and Hofmeister in 1894 may be brought about by any one of numerous causes, among which are congenital deformity, with or without dislocation of the hip, fracture, rickets, osteo-

malacia, osteoporosis, osteomyelitis, and tuberculosis. The present paper limits itself to a discussion of the so-called adolescent coxa vara, characterized by downward and forward displacement of the head on the neck of the femur. The author claims that the condition described is a distinct entity, consisting of a disturbance of the nutrition of the epiphyseal line of the upper end of the femur. This results in various degrees of coxa vara if it is not properly treated. The deformity is due to weight-bearing in heavy children, which causes a displacement of the head through the giving way of the poorly functioning epiphyseal line. This poor functioning is probably due to some endocrine disturbance and not to rickets or trauma. If the condition is taken early, reduction of the displacement can be obtained, and if this reduction is maintained long enough, complete anatomic restoration and perfect function are possible.

The roentgenographic appearances are entirely dependent on the length of time which has elapsed since the onset of trouble. The author describes them under (1) Very early; (2) Moderately advanced; (3) Late, after pain has disappeared, and (4) Stage of completed process.

Coxa Vara in Adolescence. F. C. Kidner. Jour. Bone and Joint Surg., April, 1925, p. 241.

Benign bone cysts.—The discovery of the first bone cyst is credited to Virchow, who, in 1876, came upon one at postmortem in a patient 54 years old. He believed this condition of the bone resulted from the dissolution of a chondroma or a cartilage rest, but since that time other investigators, notably Bloodgood, have disagreed with him as to the etiology. The author accepts Bloodgood's classification of bone cysts and gives the following outline:

(1) Single cyst, bony shell, no connective tissue lining.

(2) Cysts with a definite connective tissue lining, varying, as a rule, from one to two millimeters.

(3) A small cyst or cysts in a solid mass of osteitis fibrosa.

(4) No cyst, but bone shell filled with a solid mass of osteitis fibrosa.

(5) Multilocular cysts.

As to treatment, Jostes says that radical resection has been done in many cases where simple curettement and rest would have led to a good result. In some cases rest is the only requisite; others fracture spontaneously and then heal. The author believes that curettement should be done before fracture takes place, if the condition is diagnosed; thus one avoids the dangers of spontaneous fracture. Lotsch is quoted in support of the conservative treatment, and Baccarini believes that curetting removes the altered bone tissue and the abnormal vessels (due to repeated hemorrhages into the bone), leaving a clean cavity to fill with normal compact bone.

Five cases are reported, with the roentgen findings in each. In diagnosing, a careful clinical history, roentgen and physical examinations, are necessary.

Diagnosis and Treatment of Benign Cystic and Fibrocystic Diseases of Bones. Fred A. Jostes. Jour. Bone and Joint Surg., April, 1925, p. 251.

Low back pain. — This paper, the author states, is a study of the part played by sacralization—complete and incomplete—of the fifth lumbar vertebra in the production of low back pain. Complete sacralization consists in a complete bony union between the abnormal transverse process and the sacrum, while the incomplete type shows a well defined joint line between them. Both forms may be either unilateral or bilateral. The complete bilateral sacralization verges into a sixth sacral vertebra and can not be distinguished from it except by checking the number of other vertebræ. Of 87 cadavers and skeletons examined, in three (3.4 per cent) sacralization was found to be present, unilateral in all three cases. In studying the condition from the roentgenologic standpoint, 1,104 plates of the lumbo-sacral region were examined, not selected, of which 340 were children. In this series there were 37 cases (3.35 per cent) of sacralization, either unilateral or bilateral. This corresponds with the percentage found to obtain in the cadavers examined, though it might have been expected to be considerably higher in patients who had reason to have their backs radiographed. In about half of the cases of sacralization there are symptoms associated with its occurrence which may be related to it, but which are not accounted for by the anomaly alone. Anatomically and architecturally, the sacralized formation appears stronger and more able to resist strain than the usual arrangement.

Sacralization of the Fifth Lumbar Vertebra. B. H. Moore. Jour. Bone and Joint Surg., April, 1925, p. 271.

Skull fractures. — This paper analyzes 171 cases of proven skull fracture, with a mortality of 25.7 per cent. The operative mortality was 47.7 per cent, 38 cases being operated upon. Linear fractures occurred 145 times, the most common site being from the posterior parietal

region downward and forward through the temporal bone to the locality of the external auditory meatus. Depressed fractures occurred 26 times. Death followed the injury within forty-eight hours in 68 per cent of the cases. The authors state that the spinal fluid pressure is a more accurate early index of the degree of increased intracranial pressure than the ophthalmoscopic picture.

Roentgenograms of the skull should be taken in every case of suspected fracture; in many instances, especially in cases of basal fracture, the line will not be shown. On the other hand, when a linear fracture of the vault or base is shown, this fact should not be taken as a deciding factor for operation. Whenever possible, fractures of the skull should be demonstrated, just as fractures of the long bones are demonstrated.

Elaborate tabulations present the cases analyzed, and three cases are reported in detail.

Fracture of the Skull: Analysis of 171 Proved Cases. Carl W. Rand and Johannes M. Nielsen. Archiv. of Surg., Sept., 1925, p. 434.

Focal infection.—In an editorial introduction to this paper the study upon which it is based is stated to have been made possible by grants from the Carnegie Corporation of New York, the American Dental Association, and the Associated Radiographic Laboratories of San Francisco. Dr. Wisner's résumé is as follows:

"Oral focal infection is an inseparable part of general focal infection.

"The commonest primary lesions are teeth, tonsils, sinuses, and prostate.

"Secondary foci may exist almost anywhere throughout the body.

"The primary lesions are usually symptomless and need not yield pus, rendering them difficult to locate.

"The remote effects are due to bacteria or their toxic products, transported by way of the blood or lymph stream.

"Streptococci are the commonest organisms concerned in focal infections, although others may be responsible.

"Among the dental pathological conditions responsible for focal infections, periapical infections and pulpless teeth are of prime importance. Pyorrhea must also be considered.

"The dentist is one of a group of specialists whose services are requisite to the proper diagnosis and treatment of a case of focal infection.

"Local surgical treatment often requires to be supplemented by general measures, designed to build up bodily resistance against inaccessible foci."

Amplifying these statements the author goes on to say that the condition of focal infection is finding its proper place in medicine and dentistry, some rating it with tuberculosis and syphilis, as being one of the three most important of all infections. This is somewhat surprising, he states, considering the short time since the condition has been described as a clinical entity, estimates having been made that over 60 per cent of all patients admitted to hospitals are there because of some manifestation of focal infection. Formerly these cases were considered to result from totally different conditions, and it is only recently that "we have had a sufficiently clear insight to realize that all these cases belong in the same category."

The author defines focal infection as the transportation of infection from one portion of the body to another, with an infection resulting in both places. Thus, a periapical abscess may give rise to an arthritis. "But, according to this definition, we might place syphilis, tuberculosis, and, in fact, all the infectious diseases we know, in this same category. And the truth of the matter is that, broadly speaking, all these diseases *are* types of focal infection. But the condition which is commonly termed 'focal infection' is a transported infection of organisms of the staphylo-streptopneumococcus group."

The common primary foci in the body are: Periapical abscesses, pulpless teeth, paranasal sinuses, tonsils and adenoids, prostate and seminal vesicles, and the skin. The common secondary foci are: Regional lymph nodes; joints; tendons, ligaments and fascia; nerves and brain; appendix and gall bladder; kidneys; heart muscle; eyes and ears; stomach and intestines, and the lungs.

The methods by which the distant effects of focal infection are produced are by the lymphatic transportation of the bacteria, or through the blood vessels, or, as in the case of neuritis, to the dissemination of toxic products of bacterial activity, rather than to the transportation of bacteria themselves. A means of transporting infection, which has as yet not received very serious consideration, is the swallowing of bacteria and their toxic products, from foci existing in the mouth or pharynx.

In examining the teeth for possible primary foci there is, first, the chronic periapical abscess, or granuloma, to be located by the roentgenogram. "The other type of tooth in which we are especially interested is the pulpless one. It seems to be the current opinion that between 50 and 80 per cent of pulpless teeth are infected. Even if uninfected, the pulpless tooth is a constant liability, since it may, at any subsequent time, become infected. The burden of proof against this statement, it would seem, rests upon

the advocates of root canal therapy. Fortunately, there is a constantly decreasing number of teeth being devitalized, so that, in the future, this particular phase of the problem will not loom as large as it does at present."

Of interest to roentgenologists who are called upon to solve dental problems are the following statements: "There are certain writers who attribute cures to the removal of teeth which, they state, were negative radiographically. Just what we are to infer from this is a matter of conjecture. These men may be referring to nonvital teeth, calling them radiographically negative because they show no visible periapical absorption. We have already seen how nonvital teeth are to be suspected, regardless of their radiographic appearance. Again, these authors may have been dealing with teeth bearing periapical abscesses which were unobserved, either because of their small size or because of their position. It is possible that these teeth may have been affected with pyorrhea and that deep down, near the pockets, were small areas of infection that were walled off, and thus not provided with drainage. There is also the possibility that, unknown to the dentist, some other focus has been removed at about the same time as the removal of these apparently normal teeth. And lastly, there is the possibility that there is a type of infected tooth with which we are as yet unacquainted, and which our present methods of diagnosis cannot reveal."

The author condemns the extraction of large numbers of infected teeth at a single sitting as liable to result in a violent flare-up of all symptoms, adding, "Probably the cases in which a flare-up is caused are the ones which will be most benefited by the eradication of the infection." It is only the blind and ruthless ordering of wholesale extraction which he condemns.

The fact that primary foci may be inactive, and secondary ones not yet established, may be due to the fact that the lesion is draining or the body may be successfully walling off the infection, or the patient's resistance may be keeping ahead. Any or all of these conditions may break down at any time.

Local treatment should be supplemented by general measures designed to build up resistance against inaccessible foci, if such must be left within the body,—such measures as autogenous vaccines, ultra violet light, roentgen therapy, and parathyroid extract.

Focal Infection: A Medico-dental Problem. F. P. Wisner. Calif. and West. Med., Aug., 1925, p. 977.

Cancer etiology.—In 1911 Peyton Rous described a sarcoma of the fowl which metastasizes freely and generally kills the host within twenty-eight days. Second and third types of filterable hen tumor were described by Rous in 1912 and 1914. Rous studied these tumors very carefully and showed clearly that they answer every valid test which has been put forward as a criterion of newgrowths. The problem which remained when Rous concluded his work on these tumors was the determination of the nature of the filterable agent. Rous and his collaborators brought forward strong evidence in favor of its being a filterable virus—a living but extremely small microbe. Rous used, however, the term "agent" rather than "virus," because the final proof that the agent is animate, namely, its cultivation outside the body, was missing. All attempts to stain and see the virus, using for the purpose a 2 mm. apochromatic lens with eye pieces ranging from 6 to 20, had failed. "Granules" which can be stained in films made from a medium containing tissue have been seen, but they were proven not to be the virus in question, by proving the presence of such "granules" in non-tumor-producing culture fluid. In order to justify the contention that a virus is responsible in part for the production of the Rous hen sarcoma, the author believes that it is essential to show proof of the multiplication of the virus *in vitro*. He believes to have shown that such multiplication of the virus does take place, by producing the growth of these sarcomata by the use of subcultures diluted ten billion times and more.

The author has further been able to show that the Rous tumor No. 1, mouse sarcoma 37/s, rat tumor 9 and J. R. S., mouse carcinoma 63, and a human breast carcinoma all provide a factor which can replace the virus of the Rous tumor in the genesis of a chicken sarcoma. He has also shown experimentally that the virus alone is unable to bring about the malignant transformation of a cell. An adjuvant, fortunately provided in abundance by the chicken sarcoma, is necessary; this adjuvant he has called the "specific factor." He concludes as a result of his researches that cancer—using the term in its widest sense—is a specific disease caused by a virus or group of viruses. Under experimental conditions the virus alone is ineffective; a second specific factor, obtained from tumor extracts, ruptures the cell defenses and enables the virus to infect. Under natural conditions continued "irritation" sets up a state under which infection can occur. The virus probably lives and multiplies in the cell and provokes the cell to continued multiplication.

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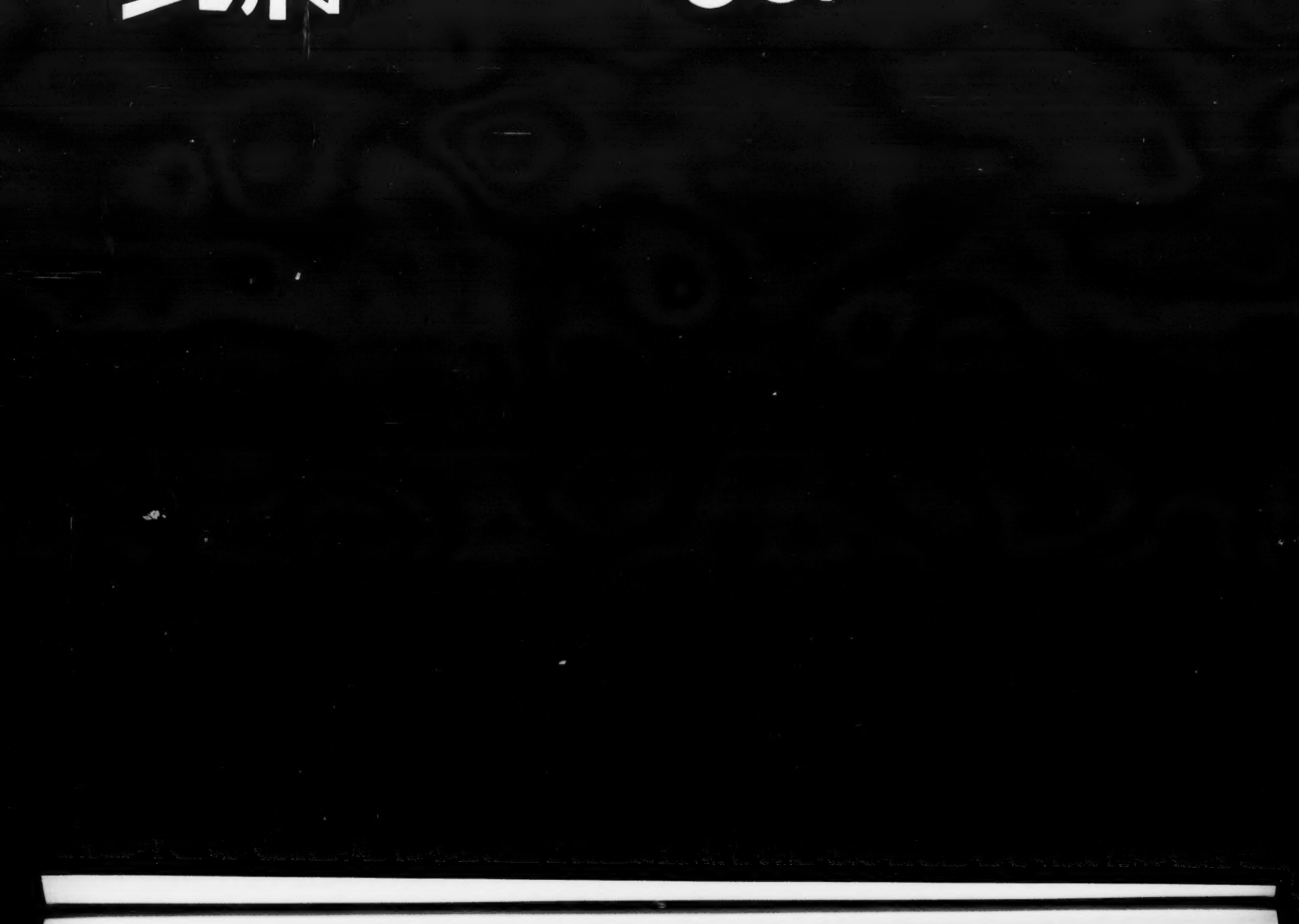
The Etiology of Malignant Newgrowths. W. E. Gye. Lancet, July 18, 1925, p. 109.